GAS JOURNAL

LIGHT ⁘ HEAT ⁘ POWER ⁘ BYE-PRODUCTS

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Editorial Notes.

His Majesty the King.

CONSIDERATIONS of party, class, and creed have now for many days been submerged in the minds of all his loyal subjects by anxious thoughts for His Majesty, lying seriously ill at Buckingham Palace. Deep solicitude is felt, indeed, far beyond the Empire, since the King, by reason of his outstanding personality, humanity, and unwavering devotion to duty, enjoys world-wide popularity and admiration. The sympathy of all is extended to what may truly be termed His Majesty's home circle, while fervent prayers are offered for his speedy restoration to health.

Private Bill Legislation.

CHANGING conditions impress themselves in various ways, and one of these is through the Parliamentary Committee Rooms. What would be the feelings of the stalwarts who took part in the titanic struggles of those halcyon days for the Parliamentary Bar when the railway companies of the country were seeking statutory authority for the laying-down of their "iron roads," could they be here to witness those self-same companies now applying for powers in connection with air services? Or what would these stalwarts have thought had they seen the railway companies only a few short months ago fighting for a footing on those very highways to which they had been superior for so long that they may, excusably perhaps, have regarded themselves as permanently secure from competition from that quarter? Then what about the tramways? Surely they were based upon a solid enough foundation. For the answer, turn again to the Parliamentary Committee Rooms. In measure after measure promoted by municipal authorities there are provisions relating to "trolley 'buses." There is no intention here of taking sides. We have no desire to choose between the railway, the motor coach, and the aerial service, or between the tramway and the trolley 'bus; our only idea is to refer to the Committee Rooms in so far as they mirror the trend of events as affecting our readers.

Let us take a glance at the gas industry. Once more we see a great falling-off from the palmy days (for agent, counsel, and expert witness) when competitive schemes of gas supply were the order of the day; but there are still too many Bills. Though the Special Order facilities under the Gas Regulation Act have done a good deal to remove this cause of complaint, we observe, in reading over the notices which have been published of the intention to promote in the 1929 Session of Parliament Bills containing clauses having reference to gas undertakings, many requirements sanctions to which it should be possible to obtain by less cumbersome and less costly procedure. The undertaking concerned, of course, has the trouble, but it is the consumer of gas who eventually is saddled with the monetary outlay. We are still hopeful that at an early date this defect may be removed; but strange indeed is the reluctance shown by those in authority to make any move in this direction. What really is the difficulty? The President of the Board of Trade speaks of "controversial legislation;" but precisely upon what grounds, we have been unable to appreciate. Perhaps, after all, it is the case, as suggested by Mr. A. W. Smith (General Manager and Secretary to the Birmingham Corporation Gas Department), when unveiling a Murdoch memorial tablet at the Smethwick Corporation Gas-Works last week, that the gas industry is still prejudiced by the amazing mentality manifested by its opponents at its birth.

However this may be, for the moment we must accept things as they are; and hence it is that for the forthcoming Parliamentary Session there is promise of over a dozen Private Bills containing clauses affecting gas supply. The objects of the promotions naturally vary; but there is to be found here, as elsewhere, a clear demonstration of the trend of events. Amalgamation figures in more than one instance; and what stronger indication than this could there be of the direction in which modern business is tending? Amalgamations in the gas industry are not by any means an innovation. In the breezy days of yore—those days when a straight fight was more popular than is the case in these enlightened times—gas undertakings carried on their business differently. Rival mains running down the same street kept things lively, and frequently eventuated in one company supplying gas for which another received payment. Though temporarily, no doubt, this kind of thing resulted in the putting into force of scales of charges which were gratifying to the consumer, the end was inevitable. Thus amalgamation came early into the industry. Now we have the same process with a different aim. Not the joining-up of competing forces under compulsion of the instinct of self-preservation, but the combination of neighbouring undertakings who see the way thereby to increase the benefits which they may be able to confer upon the community.

Procedure of this nature is proposed by the Gas Light and Coke Company, who are promoting a Bill for the acquisition of the undertakings of the Grays and Tilbury Gas Company and the Pinner Gas Company; and similarly the South Suburban Gas Company are proposing to take over the undertaking of the Northfleet and Greenhithe Gas Company. Another indication of the direction in which the industry is moving is furnished by the Newcastle-upon-Tyne and Gateshead Gas Company and the Wandsworth, Wimbledon, and Epsom District Gas Company, both of whom are seeking the application to their undertakings of the principle of a basic price of gas and a basic rate of dividend. The Yorktown (Camberley) and District Gas and Electricity Company are putting forward a scheme of a somewhat unusual character; their Bill being to provide for the transfer to them of the gas undertaking of the Borough of Wokingham. The purchase transaction with which the industry is more familiar is that by local authority from company; and examples of

this are provided by the Newport (Salop) Urban District Council, who are acquiring the undertaking of the Newport Gas Light and Coke Company, and by the Windermere Urban District Council, who are taking advantage of a clause inserted in the Windermere District Gas and Water Company's Act of last year, which provided that, if they chose to promote a Purchase Bill in the next Parliamentary Session (the price agreed upon being £74,000), the Company were not to oppose it. Other measures may raise interesting points; for the notices of Bills suggest varied requirements. They give evidence of continued activity on the part of several progressive gas undertakings, including those at Aldershot and Sheffield.

Coke Sales.

SHALL coke remain the sleeping partner in the gas industry? Surely it is high time it was awakened. Let us consider for a moment the growing efficiency of gas sales departments, and contrast it with the methods adopted for the selling of coke—a product which is responsible for a vast amount of revenue, and has an extremely important bearing on the price at which consumers can be supplied with gas in any area. In the former departments we have trained salesmen (in the larger undertakings divided into specialist classes), admirable showroom displays, extensive advertising in the Press and in other directions, intensive seasonal campaigns, and in many instances effective maintenance systems. Rightly, gas undertakings regard it as their duty to offer good advice regarding the purchase, installation, upkeep, and renewal of gas-consuming appliances. New methods and more efficient practices are broadcast at their birth, so that the community may take full and immediate advantage of the development of gas technique. Compare this service with that relating to the proper and efficient utilization of coke. Are consumers of coke advised immediately their appliances will not give the satisfaction which they should afford? Are their individual requirements as to particular grades of fuel studied closely, and is delivery invariably prompt, courteous, and up to standard? And yet in many instances coke is absolutely the backbone of the gas business.

Thought on the whole situation can only lead to the conclusion that our industry has much lee-way to make up in the matter of coke sales; and that the same state of affairs exists in the gas industry in the United States of America is indicated by the recent Report of the Carbonization Committee of the American Gas Association, in which it is stated that the year 1927 witnessed a pronounced trend towards the substitution of coal gas for water gas. Comparatively speaking, the problem of domestic coke sales has not yet begun to be tackled seriously. We cannot even say with any degree of certainty what characteristics are required of coke for various domestic heating purposes; and no determined, sustained attempt seems to have yet been made to supply consumers with a fuel which at all times is uniform. And to our mind, uniformity of quality is of as great a value as standard of quality. This idea has become axiomatic in gas supply, where it is universally recognized that fluctuations in pressure or calorific value have far more influence on satisfactory performance than has any particular calorific value. It is of no importance whether the gas has a heat content of 400 B.Th.U. per c.ft. or one of 500 B.Th.U.; on the other hand, uniformity of supply is essential. Equally necessary is the uniformity of coke supplies to any particular customer or class of customers; for it is a fact that almost any process employing coke will suffer more from a maladjustment due to variation in performance from day to day than it will suffer from the use of an inferior coke—if only the latter be reliably inferior. As Mr. H. M. Chapman emphasizes in the American Gas Association's report to which we have just referred, a supplier of low-price coke can have no excuse for furnishing a batch of better coke, by the circumstance that he is giving the customer more than he has paid for. Actually, the customer is getting something less than he bargained for—namely, a reliable performance, to the presumed character of which his processes have been adjusted. Such misbranding does not have to be deliberate and intentional to be unethical.

Automatic regulators are installed in the retort house; recording calorimeters are the order of the day in any well-equipped works of a capacity of anything except the smallest; pressure governors are dotted about the district; boosters are brought into action during periods of peak load. That is indicative of the care exercised in regard to uniformity of gas supply. On the other hand, there is no denying that in many places coke—the major product as far as bulk is concerned, and upon which often depends the economic success or otherwise of the whole process of carbonization—is handled without due care. This is how Mr. Chapman sums-up the situation: "A thorough-"bred product is given a truck-horse care; and what has "been built-up by science is destroyed by lack of common "sense."

Apart entirely from the chemical constitution of coke, the question might well be raised as to what satisfactory measures are at present taken to ensure that the public may have at their disposal various cokes having physical characteristics suited to specific requirements. Is the enlightened policy of to-day merely a matter of screening the coke into different sizes, of stocking the various grades, and then of inviting the sales departments to dispose of it, or the public to take that size which they think best? To what extent have investigations been undertaken to determine the relative efficiencies of different sizes, and various mixtures of sizes, for use in particular appliances; and to what extent is the desirability of re-screening sized coke taken from storage actually translated into practice?

The "Regenerative" Gasification System.

AN interesting paper—though it could hardly be termed conclusive—was read by Mr. A. K. Collinge, of the Preston Gas Company, before the Manchester and District Junior Gas Association on Saturday last. It deals with the working and development of the "Regenerative" complete gasification system which was introduced by Dr. M. W. Travers and the late Mr. F. W. Clark six years ago. The first plant working upon this principle was constructed at Aylesbury, and had a capacity of 300,000 c.ft. a day; and later two more units were erected—one at Preston rated at 500,000 c.ft., and one at Harrow rated at 1 million c.ft. Mr. Collinge refers particularly to experiments which have been carried out on the installation at Preston.

Study of the contribution leads to the impression that the plant is restricted in respect of choice of coals—that is, if high efficiency and untroubled working are to be maintained—and indicates that theoretical calculation of the amount of heat needed for the process of converting the thermal energy of the coal into gaseous form provides no accurate clue to the actual practical requirements. And without losing sight of the difficulties of the pioneer, or of the fact that the evolution of any plant—be it for gas-making or for any other purpose—must be marked by many set-backs, we are bewildered by the author's lengthy account of the operation of a stirring device now incorporated in the Preston unit. It was found, states Mr. Collinge, that a greater volume of gas had to be circulated than was calculated in theory. This was thought to be caused by the gas forcing channels through the plastic coal, resulting in uneven carbonization. It was also realized that in the existing type of generator it was impossible to deal with coals having a high percentage of smalls and fines. The problem was attacked by the inventors, and it was decided to instal a stirring device to operate in the upper portion of the generator.

This stirrer has two arms. At first the top arm was positioned 7 in. below the level of the coal, and the lower arm 3 ft. 7 in. At these levels, the stirrer was far from successful; and the next step was to decrease the depth of the fuel bed to such an extent that there was only 1 ft. of cover for the lower arm. Still the outcome was not happy. Again the level of the fuel bed was dropped—this time by a further 6 in.—so that the bottom arm now merely levels and agitates the surface of the coal. The author has a good deal to say regarding the benefits which have accrued as a result of the incorporation of this

device when working with coals containing a considerable proportion of small material and dust; but he observes that, if moderately large coal, free from smalls and dust, is used, it is doubtful whether the advantage gained is worth the extra cost of the plant and its upkeep. We are very surprised that no attempt has been made to assess the influence of merely decreasing the depth of the fuel bed, irrespective of the stirring device—or, if an attempt has been made, why it is not mentioned in the paper. It is a pity that the author did not discuss the advantage, if any, of having a portion of the generator seemingly applied to no useful purpose, and did not refer to the heat capacity of fuel beds of different depths.

In an appendix to the paper, the author compares the cost of a therm of gas produced in the "Regenerative" plant with that made in an ordinary carburetted water gas unit. The figures are in no sense absolute, and some of them are assumptions. In the result, however, he finds that the corresponding costs are 2·60d. per therm for "Regenerative" gas, and 3·37d. for carburetted water gas. To arrive at this conclusion, he assumes that a gallon of oil produces 0·9 therm—a figure considerably below that of normal C.W.G. practice. The most important figure of all, however, is the calorific value of the "Regenerative" gas, which is given as 360 B.Th.U. per c.ft. A yield of 171 therms of 360 gas seems to us surprising.

The author sums up the chief practical advantages of the complete gasification plant over a separate retort and water gas plant as follows: The capital outlay is about three-fifths; the labour employed is in the neighbourhood of one-third; and less than half as much solid material has to be handled. And he states that the method of carbonizing the coal by the circulation system is an economic success. Unfortunately, he does not discuss the question of reliability; nor does he mention anything about condensing plant. During the run, the quantity of gas circulated is about five times as much as is made; and since the circulating gas is drawn from the last scrubber, it follows that the condensing plant has to be of a capacity greatly in excess of that normally needed. With a small installation making (say) one million c.ft. a day, the effect of this may be overlooked; but the matter might appear in a different light when a unit of much greater capacity was being considered.

Gas Fatality at Stockport.

There will be regret throughout the industry at the news of the sad gas leakage fatality at Heaton Norris, near Stockport, whereby, in the early hours of last Friday morning, an entire family of six persons lost their lives, while a number of other people were more or less seriously affected. The cause was leakage of gas from a crack in a 2-in. pipe beneath the pavement immediately in front of the house in which the stricken family were sleeping; there being a hole in the wall of the house a few inches below the pavement level. More than one possible cause of the leakage suggests itself; but it will be necessary to await the result of the inquest before arriving at a definite conclusion. Even then, of course, the matter may not be cleared up. Accidents of this nature are fortunately very rare—particularly when it is realized that in the United Kingdom there are nearly 50,000 miles of mains, and in addition an enormous total length of service pipes—but when they do happen they bring home to one the heavy weight of responsibility that attaches to the distribution departments of gas undertakings. Their task of watching over the safety of the public is well done; and it is necessary that people should be abundantly assured of this, in order that perfect confidence in an essential public utility service may be maintained.

Refractory Materials and the Carbonizing Industries.

In a lecture before the London and Southern District Junior Gas Association last Friday evening—an account of which will be found in later columns of our issue to-day—Mr. A. T. Green suggested that the carbonizing industries pay insufficient attention to the manufacture and performance of refractory materials; and, considering the extremely important bearing they have on the economics of the carbonization process, we are inclined to agree with him. The gas industry has, of course, afforded considerable financial assistance to research work on the subject; but, while this work has accomplished a great deal, it has in actuality only touched the fringe of possible improvements. A point which occurs to us is that, without immersing oneself wholeheartedly and enthusiastically in the problem of efficient refractories, one is apt to become a trifle impatient of what at first blush appear to be the nebulous findings of research, and to lose sight of the hundred-and-one influences, working in different—sometimes in opposite—directions, which affect the performance of refractory materials generally. To date, for example, most of the scientific investigations point out the value of compromise; and though the practical man lives continually in a state of compromise, he is commonly offended when the latter is the outcome of research. For some reason he anticipates that scientific investigation must result in immediate definition; and for this very reason, research on refractories appears to be singularly lacking in attraction. The keynote of Mr. Green's lecture was that the satisfactory working of refractory materials is essentially a compromise—in keeping with the facts that fireclay and siliceous products are generic terms covering a multitude of virtues and vices.

Fireclay and Silica.

Naturally, Mr. Green had a good deal to say with regard to the relative merits of fireclay and silica. Our impression of his remarks in this particular, which were forceful, is that fireclay will still be employed for comparatively low carbonizing temperatures, but that, for high temperatures, silica is not only desirable, but essential. The increase of its thermal conductivity and diffusivity with increasing temperatures, and its under-load resistance to extremely high temperatures, render it paramount. Mr. Green thinks, rightly or wrongly, that the trend of modern practice is towards higher, and still higher, temperatures. The discussion to which the lecture gave rise was of great interest. It was evident, for instance, that some of the speakers—Mr. T. H. Prater, of the Isle of Thanet Gas Company, was one—still enjoy tender feelings towards fireclay (or at any rate siliceous) materials. We call attention to Mr. Green's observations on joints and jointing cements, and to his statement that, though the work of research associations is a great and necessary help towards the solution of the problems of the manufacture and utilization of refractory materials for gas-works, the collection and collation of data by the technical staffs of contracting firms and individual gas plants are equally vital to a successful issue.

FORTHCOMING ENGAGEMENTS.

[*Secretaries of Gas and Kindred Organizations are asked to assist in making this diary of events as complete and useful as possible by sending the earliest intimation of all meetings.*]

Dec. 8.—SCOTTISH JUNIOR GAS ASSOCIATION (EASTERN DISTRICT).—Meeting and visit to the Leven Gas-Works and the Durie Foundry, Leven.

Dec. 8.—WALES AND MONMOUTHSHIRE JUNIOR GAS ASSOCIATION.—Meeting, and visit to the National Oil Refineries at Llandarcy.

Dec. 12.—BRITISH COMMERCIAL GAS ASSOCIATION.—Meeting of the Executive Committee, 3 p.m.

Dec. 12.—SCOTTISH JUNIOR GAS ASSOCIATION (WESTERN DISTRICT).—Visit to the Union Works of the Scottish Tube Company, Ltd., Coatbridge.

Dec. 14.—MANCHESTER DISTRICT INSTITUTION OF GAS ENGINEERS.—Meeting at Burnley. Paper by Mr. J. H. Clegg, Gas Engineer and Manager to the Burnley Corporation, on "Dry Cooling of Coke by the Sulzer Plant."

Dec. 14.—LONDON AND SOUTHERN DISTRICT JUNIOR GAS ASSOCIATION.—Meeting at the Westminster Technical Institute, Vincent Square, at 7.30. Paper by Mr. A. T. Gilbert, on "The Evolution of the Gas Meter."

Dec. 15.—YORKSHIRE JUNIOR GAS ASSOCIATION.—Meeting at Leeds University. Paper by Mr. H. J. Hodsman, M.Sc., on "The Radiation from Gas Burners."

Dec. 19.—BRITISH COMMERCIAL GAS ASSOCIATION.—Meeting of the General Committee, 2 p.m.

Jan. 17.—SOCIETY OF BRITISH GAS INDUSTRIES.—Council meeting in the afternoon.

INSTITUTION OF GAS ENGINEERS.

Dec. 11.—Gas Education Executive Committee, 4 p.m.

PERSONAL.

The Batley Corporation have appointed Mr. SWINTON B. DEAN, the present Assistant Gas Engineer, to take up the position of Mr. R. H. Duxbury, Gas Engineer, who has been appointed Engineer to the South Bank and Normanby Gas Company. Mr. S. B. Dean was appointed Technical Assistant at Batley in March, 1920, and four years ago was given the post of Assistant Engineer and Technical Assistant. He was previously at the Longwood Works of the Huddersfield Corporation Gas Department, and prior to this served his articles with Mr. J. H. Brearley, M.Inst.C.E., at the Longwood and Slaithwaite Gas Company. He will take up duties at Batley on Jan. 1 next, on which day Mr. Duxbury commences his duties with the South Bank and Normanby Gas Company.

Col. Sir EDWARD ALLEN BROTHERTON, Bart., D.L., LL.D., the Chairman of Brotherton & Co., Ltd., who has been nominated as High Sheriff for Yorkshire for next year, has given a donation of £2000 to the Leeds Infirmary Radium Fund.

At a meeting of the Board of Directors of the Scottish Tube Company, Ltd., held on Nov. 30, Mr. HENRY J. RHODES was unanimously appointed Chairman of the Company, in succession to the late Mr. Andrew Eadie.

Mr. DAVID D. BRUCE, Assistant Gas Manager to the Buckhaven and Leven Gas Commissioners, has been appointed Gas Manager to the Thurso and North of Scotland Gas Corporation, Ltd., who have works at Thurso and Golspie. Mr. Bruce entered the gas profession as Assistant Gas Manager to the North Berwick Town Council in 1913; and in 1915 he enlisted in the Royal Engineers, being posted for special duty with the War Department Motor Boat Service. On demobilization, he served under the Buckhaven and Methil Town Council, and in 1921 was appointed Manager of the East Wemyss Works. Latterly he became Assistant to the General Manager of the Buckhaven undertaking, which had amalgamated with the Leven and Methil undertaking, and is governed by a Board of Commissioners from the Buckhaven, Methil, and Leven Town Councils. Mr. Bruce is a Past-President of the Scottish Junior Gas Association (Eastern District).

OBITUARY.

The death occurred, on Nov. 28, of Mr. W. B. RHODES, aged 74, formerly Accountant to the Accrington District Gas Board. Deceased was the son of the late Alderman Swain Rhodes, J.P., who was Chairman of the Accrington Gas Company. Altogether, Mr. Rhodes had 41 years' service with the undertaking—nine years with the old Company, and 32 years with the Board.

The unexpected and sudden death, at the age of 77, of Mr. JOSEPH FISHER, Managing Director of Messrs. J. Fisher, Ltd., on Nov. 14, at the Towers, Belmont, Hastings, came as a great shock to the glass trade in this country and abroad. Mr. Fisher started his career at the age of 16, and carried on to the last—his business being a hobby with him. He spent the last three-quarters of his life in England; and he had always been recognized as a great artist in the glass world. He was greatly liked and admired by all who came in contact with him; and he never refused a helping hand to anyone.

ON THE ELECTRICAL SIDE.

A Review of London Electricity Charges.

It is announced that the London and Home Counties Joint Electricity Authority have authorized a Special Committee to undertake a review of charges and conditions imposed by electricity undertakers in their district. It has been suggested by the Electricity Commissioners that the review should be more particularly directed to a comparison of the bases and amounts of the various charges and tariffs adopted for supplies of electricity for lighting, for general domestic purposes, and for power; the charges made for the hire of ordinary electricity meters and also for prepayment meters and any fittings installed in connection therewith; the extent to which the charges and tariffs in the case of individual undertakings are due to particular circumstances of the undertakings concerned; the steps which could be taken to secure greater uniformity of charges and tariffs throughout the district; the form of multi-part tariff or tariffs best suited to the requirements of the district, and the steps necessary to bring about the general adoption of such tariffs; the facilities afforded by undertakings in regard to the hiring of apparatus, &c., hire purchase, and assisted wiring in order to encourage the domestic demand, and so reduce prices; and the effect upon charges for electricity of the sliding-scales of price and dividend prescribed by the London Electricity Acts, 1925, and by other special or Provisional Orders in force in the district.

Wandsworth and the Two-Part Tariff.

As the result of an agitation for lower charges for electricity supply in the borough of Wandsworth, the County of London Electricity Supply Company, Ltd., have informed the local Council of their decision to put in force, from and after the December quarterly meter readings, two classes of two-part tariff—one for domestic consumers and one for business consumers (shops, offices, public institutions, churches, and premises used for purposes of a business nature). So far as domestic consumers are concerned, the tariff remains the same as that decided upon last July. The only amplification of the scheme is that household premises will be divided into twelve groups—lettered "A" to "L"—the fixed quarterly charge being 15s. for group "A" houses, with a floor area of 1200 sq. ft., with an increasing scale up to £3 2s. 6d. per quarter for group "L" premises, with a floor area of from 5001 to 5500 sq. ft. Consumers will doubtless find it the easiest thing in the world to ascertain just how they are likely to stand under the scheme, if they consult published details of two actual examples of the effect of the two-part tariff on each of the twelve classes of houses; one example being for a consumer using below average quantity, and the other for a user taking more than the average. The schedules show that, under the existing charge of 6d. per unit, *plus* meter rents, in the case of "under-average" consumers, the cost per unit works out at 7·07d. down to 6·25d.; while under the two-part tariff the cost would range from 6·38d. to 5·75d. Similarly in the case of "over-average" consumers, the schedules indicate that the current cost ranges from 6·8d. to 6·16d., including meter rents, under the 6d. per unit charges, and from 5·32d. to 3·72d. under the two-part tariff. The Council's Electricity Committee feel that, to encourage the use of electricity in small houses, a lower minimum than 1200 sq. ft. should be introduced—*i.e.*, one of 10s. per quarter, or £2 a year, for houses of up to 800 sq. ft. floor area.

Joint Control of Gas and Electricity.

On more than one occasion the "Electrical Times" has been asked for the names of towns where joint control of gas and electricity formerly existed, and "had to be abandoned." Now our contemporary has obliged, by publishing a goodly list of towns which "once had Joint Gas and Electricity Committees." Some two dozen names are included in this array; and we have not the slightest doubt that they have been selected with the utmost care. It is information that must have required some labour to compile, particularly in view of the fact that "had to be abandoned" is so definite a stipulation. Some dissolutions, it is conceivable, may have come about through other causes than compulsion; and not one may have been the result of proof that general good would accrue from two undertakings which belonged to the ratepayers entering into keen competition with each other to secure the custom of those self-same ratepayers. But, however this may be, we are assured that not a single one of the towns enumerated now runs its electricity and gas under the same Committee. We accept the assurance. Our uncertainty is not upon this point, but as to how two at any rate of the places came to be included in the list at all. The towns referred to are Harrogate and Portsmouth, which at the present moment enjoy the good fortune of being served by two of the most efficiently operated and progressively administered Gas Companies in the country.

Hydro-Electric Progress in Canada.

A Canadian Supplement was on Monday of last week a feature of the "Financial Times;" and to it the Hon. Charles Stewart (Minister of the Interior) contributed an article illustrative of the latest achievements and projects in hand in connection with one of the Dominion's most striking and important natural assets. There is ample water power available within easy transmission distance of practically all the larger cities. In the districts containing the least water power—that is to say, in the southern portions of Alberta and Saskatchewan—there are large resources of coal. In fact, 82 p.ct. of the developed water power and roughly 60 p.ct. of the total resources are situated in the coal-less provinces of Ontario and Quebec, which also produce about 80 p.ct. of the value of manufactured products of the Dominion. The central electric station industry has a total installation of approximately 3,904,678 H.P., of which 96 p.ct. is water-power. The hydro-electric generating stations, 308 in number, may be sub-divided into 218, maintaining a combined installation of 2,645,474 H.P. operated by commercial organizations, and 90, with a combined installation of 1,259,204 H.P., operated by municipalities, Government Commissions, or other public bodies. The census returns for 1926 showed a total installation of steam power in the Dominion of only 92,570 H.P. A recent review of conditions indicates that during the present year as much as 550,000 H.P. will be added to the total water power installation in Canada, either in new developments or in additions to existing stations.

SOCIETY OF BRITISH GAS INDUSTRIES.

Council Meeting.

A Meeting of the Council was held at 56, Victoria Street, Westminster, on Thursday, Nov. 22—Mr. R. J. MILBOURNE, Chairman, presiding. Those present were: Messrs. C. A. Goodall (Vice-Chairman), T. A. Braddock, Samuel Cutler, George Clark, F. J. Gould, G. J. Jackson, A. H. Lymn, J. W. Scott, B. B. Waller, F. West, Col. E. A. Wilson, E. J. Davison (Hon. Secretary), and Arthur L. Griffith (Secretary).

Apologies for absence were reported from Dr. E. W. Smith, and Messrs. F. Dobson, E. J. Fox, R. B. Hodgson, H. M. Thornton, and C. R. F. Threlfall.

The Chairman referred in feeling terms to the death of Mr. Frederick G. Cockey, who had been a very active and useful member of the Society. He served as Chairman of Section V. for three years, and was Vice-Chairman of the Council in 1920-21; but pressure of other duties prevented him from proceeding to the Chair. He will be much missed in the gas industry. The Secretary was instructed to convey the sincere sympathy of the members to his relatives.

At the request of the Chairman, the members stood in their places as a mark of respect.

A letter was read from Mr. Charles S. Bennett resigning the Chairmanship of Section III., owing to the pressure of other duties. The resignation was accepted with great regret, and thanks were expressed for his past services.

A letter was read from Mr. Robert Watson, of Doncaster, with comments on his Report on the International Commission on Illumination held in America, when he represented the Society as well as the Institution of Gas Engineers. The Secretary was instructed to convey to Mr. Watson their hearty thanks for, and appreciation of, his services.

Col. E. A. Wilson has been elected Chairman of Section VII. in place of Mr. H. Talbot (resigned).

The following were appointed a Sub-Committee to meet the Sub-Committee of the British Commercial Gas Association to discuss the lighting load question: Mr. R. J. Milbourne, Col. E. A. Wilson, and Messrs. F. J. Gould, P. H. Sugg, and F. C. Tilley.

The following appointments on Committees have been made.

Joint Committee, Gas Industries Section, British Industries Fair, Birmingham, 1929—Mr. A. W. Glover, in place of Mr. H. Talbot (retired).

British Engineering Standards Association, Illumination Committees—Col. E. A. Wilson, in place of Mr. H. Talbot (retired).

EVENING STAR LODGE, No. 1719.

Election Meeting.

The election meeting of the Evening Star Lodge, No. 1719, was held on Nov. 28, in the Grand Temple of Freemasons' Hall, Great Queen Street.

In consequence of the lamented death of W.Bro. F. G. Cockey, I.P.M., the Lodge was in mourning; and his place was occupied by W.Bro. A. E. Broadberry, P.M., L.R. Feeling reference was made from the chair by the W.M., W.Bro. A. L. Croager, to the great loss which the Lodge had sustained; and the brethren signified their sympathy with the bereaved ones in accordance with masonic tradition.

The preliminary business having been transacted, the ceremony of raising Bro. William R. Edgar and Bro. David E. Terrace was proceeded with, in the course of which the W.M. was assisted by W.Bro. Charles Clare, P.M., P.G.St.B., Middlesex. Thereafter Bro. George Hay Morgan, K.C., and Bro. Robert W. Hunter were passed a degree.

The ballot for the election of W.M. for 1929-30 resulted in the unanimous election of W.Bro. James Foreman, S.W., and that for the office of Treasurer in W.Bro. A. E. Croager, P.M., P.P.G.D., Kent, being elected.

On the motion of the Treasurer, it was resolved that, as an expression of the brethren's appreciation of his services as W.M., a P.M. jewel be presented to W.Bro. A. L. Croager when he retires from the chair. It was decided to send a donation of 25 guineas for the forthcoming festival of the Royal Masonic Institution for Boys, at which the W.M. is to represent the Lodge as steward.

At the subsequent dinner in the Connaught Rooms, the Chairman, in proposing the Health of His Majesty the King, made feeling reference to his illness, and expressed the fervent hope that the Great Architect would soon restore him to health.

Definitions and Formulæ for Students.—Sir Isaac Pitman & Sons, Ltd., have published, at 6d. net each, two booklets bearing the foregoing title—one dealing with heat engines, and the other with electricity.

A SNAP FROM VANCOUVER.

Mr. F. West, President of Messrs. West's Gas Improvement Company, in visiting the many plants supplied by his firm in various parts of the world, recently made an extensive tour through Western Canada. There he visited the plant of the B.C. Electric Railway Company at Victoria, B.C.; and he is shown in this photograph with Mr. Hewlings, Superintendent of the plant.

ASSOCIATION OF PUBLIC LIGHTING ENGINEERS.

At a recent meeting of the Council held in Birmingham, the decease of Mr. Noah Wright (President-Elect) was reported, and received with deep regret. Steps were taken to fill the vacancy; the choice falling upon Mr. S. B. Langlands, J.P., of Glasgow, the first President of the Association.

The Council considered afresh the invitation received at the Sheffield conference from the Corporation of Bournemouth for the Association to hold their annual meeting (1929) in that town, in view of the then President-Elect being their officer. As the result of communications with the Corporation, the Council have decided to hold the meeting and conference there, under the presidency of Mr. Langlands. It was also decided to hold an exhibition of public lighting appliances in connection therewith. The meeting was fixed for Sept. 9 to 12.

Mr. Robert Beveridge, Lighting Inspector to the City of Edinburgh, was added to the Council in the place of the late Mr. Wright.

In connection with the exhibition of public lighting appliances, those firms willing to take part should signify their assent in writing to the Hon. Secretary, Mr. W. J. Liberty, 68, Victoria Street, S.W. 1.

The Council decided to hold a general meeting of the Association at the British Industries Fair at Birmingham during the third week in February next. Full particulars of this will be issued later.

"Glasgow Commercially Considered."—The Corporation of Glasgow have published a beautifully illustrated brochure in the hope of attracting new industries to the city. It is representative of the numerous trades carried on therein. Copies may be obtained gratis on application to the Town Clerk, City Chambers, Glasgow. The brochure has been produced under the auspices of the Kelvingrove Publishing Company, Ltd., 108, Renfield Street, Glasgow.

Safety in Mines Research Board.—In the course of an investigation by the Lancashire and Cheshire Coal Research Association into the action of pyrites in relation to the spontaneous combustion of coal, a paper (Safety in Mines Research Board Paper No. 26) was published about a year ago in which H. Macpherson, N. Simpkin, and S. V. Wild gave a general account of the occurrence of pyrites in coal and of the chemical composition of the pyritic material both before and after oxidation. Another paper, by the same authors, entitled "Pyritic Oxidation, with special reference to the Ravine Seam," has just been published ("S.M.R.B." Paper No. 47, H.M. Stationery Office, Adastral House, Kingsway, W.C. 2; 1s. 6d. net) which gives a comparison of the behaviour on oxidation in the laboratory of the pyrites contained in coal taken from the Ravine Seam, Lancashire, and representing the complete seam from top to bottom, with the behaviour of the corresponding coal *in situ*. The authors conclude that, while the oxidizable pyrites contained in this coal may assist in a minor degree in the self-heating of the coal, the most important effect of the pyrites is evidently the disintegration caused in the coal by its oxidation and the greater bulk of the oxidation products.

GAS ACTS FOR 1928.

(*Concluded from p. 465.*)

TOTTENHAM DISTRICT LIGHT, HEAT, AND POWER COMPANY.

This is an Act which provides for the transfer to the Tottenham District Light, Heat, and Power Company of the undertaking of the Waltham and Cheshunt Gas Company, whose area adjoins that of the Tottenham Company. The issued capital of the Waltham Company now consists of 2000 original shares of £10 each, entitled to a standard dividend of 10 p.ct. per annum; and 3807 additional shares of £10 each, entitled to a standard dividend of 7 p.ct. The standard dividends on these ordinary shares are subject to increase or decrease in accordance with the decrease or increase below or above the standard price of 19d. per therm; and the price at present charged by the Company for gas to ordinary consumers is 14d. per therm. The Company have issued 4 p.ct. debenture stock to the nominal amount of £17,750, and redeemable debenture stock to the nominal amount of £7075 bearing interest at the rate of 7½ p.ct. The price now charged by the Tottenham Company for gas supplied to ordinary consumers is 9d. per therm.

The Waltham Company have agreed to sell their undertaking to the Tottenham Company upon the terms set forth in the Act. The date of transfer is to be the first day of July or the first day of January next following the date of the Act. Each holder of 10 original shares of £10 each in the Waltham Company will receive in exchange £156 17s. 3d. of "B" consolidated ordinary stock of the Tottenham Company to be created; and each holder of 10 additional shares of £10 each is to receive £109 16s. 1d. of such "B" consolidated ordinary stock—and so on in proportion for any less number of shares. The holders of the debenture stocks will receive the same amounts of similar debenture stocks (subject, in the case of the redeemable stock, to the same conditions) in the Tottenham Company. The necessary stocks to carry out this scheme are to be created on the date of transfer.

The Directors of the Waltham Company are to receive a sum equivalent to seven years' purchase of the annual remuneration (with the income-tax thereon, if this was paid by the Waltham Company) of the Board for the year 1926; the sum to be divided among them in such proportions as they may agree. The Auditors holding office at the date of transfer are to be paid three years' purchase of their remuneration for 1926. The Engineer, Manager, and Secretary is to be paid by way of compensation for his loss of office such a sum as may be agreed between him and the Tottenham Company, or, failing agreement, as shall be determined by an arbitrator. Provision is made for the taking over of other officers and servants of the Waltham Company.

The price to be charged by the Tottenham Company, otherwise than under special contract, for gas supplied to consumers within the Waltham district during the period of ten years from and after the reading of the meter indices in respect of the quarter following the date of transfer shall exceed the price per therm for the time being charged by the Company in the Tottenham district by the sum of 4d. per therm, and thereafter by the sum of 3d. per therm. [In the Bill as originally drafted the words were "may exceed."] A proviso has been added to the clause to the effect that any time after three years from the passing of the Act the Board of Trade may, on the application of the Company or of the Hertfordshire County Council, or of any local authority having jurisdiction within the Waltham district, by Order alter and amend these provisions; but before making any such Order, the Board shall give notice of the application to the Middlesex County Council and all local authorities having jurisdiction in the Tottenham district, and shall consider any representation with regard to such application which may be made by them. For the purpose of ascertaining the rate of dividend payable on the ordinary stock, the price charged by the Company shall be deemed to be that charged by them for gas supplied in the Tottenham district.

The name of the Company is to be the "Tottenham and District Gas Company." The existing "A" consolidated ordinary stock of the Company is to be converted into "B" consolidated ordinary stock and 5 p.ct. preference stock. For each £100 of "A" stock entitled to a standard dividend of 5 p.ct. per annum, there is to be exchanged £100 of "B" stock and £30 of preference stock. To carry this into effect, there is created £120,000 of "B" ordinary stock and £36,000 of 5 p.ct. preference stock. Power is given to raise new capital to the extent of £200,000 (including premiums) in "B" stock or preference stock, with the usual borrowing powers.

The clause relating to the capital reserve fund, which was reproduced in the "JOURNAL" for Feb. 1 last, was subsequently deleted from the Bill. Clauses have been added for the protection of the Lee Conservancy Board and for other parties. Lands are scheduled for use for the manufacture of gas and residual products.

[*Parliamentary Agents: Messrs. Lees & Co.*]

WINDERMERE GAS AND WATER COMPANY.

This is an Act which relates to both the gas and the water portions of the Windermere District Gas and Water Company's undertaking. The standard rate of dividend on the gas capital authorized to be raised by the Company's Act of 1862 is fixed at 10 p.ct., and on the 1889 capital at 7 p.ct., with a standard price of 13·2d. per therm, and a slide of 5s. p.ct. for each one-fifth of a penny per therm rise or fall in the charge for gas. In the Bill as originally drafted, the standard price was put at 15d. per therm. The calorific value is to be 500 B.Th.U. The charges authorized are to have effect as from the commencement of the quarter ending on June 24, 1929. For the hire of a prepayment meter and fittings, the maximum charge shall be 2·4d. per therm if a cooking stove is included, and 2d. without a cooking stove. A maximum charge of 1s. is fixed for special meter readings. In the Bill, the figure was put at 2s.

When the measure was before the Unopposed Bills Committee of the House of Commons, it was stated that there had been negotiations between the Company and the Windermere Urban District Council, as the result of which a clause had been agreed, providing that if the Council promoted a Bill in the forthcoming session for the purpose of purchasing the Company's gas and water undertaking, at an agreed figure of £74,000, the Company would not oppose. This clause appears in the Act.

[*Parliamentary Agents: Messrs. Sherwood & Co.*]

YORK TOWN AND BLACKWATER GAS COMPANY.

This is an Act to consolidate and convert the existing capital of the York Town and Blackwater Gas Company, and to give them power to raise additional capital. The 300 original shares, the 730 old shares, and the 5300 new ordinary shares, all of £10 each, are to be converted and consolidated into one class of stock, to be called consolidated ordinary stock, entitled to a standard rate of dividend of 5 p.ct. per annum. For each original share, there will be given in exchange £20 of consolidated ordinary stock; for each old share, £14 of stock; and for each new ordinary share, £14 of stock. The 150 preferred shares of £10 each, the £49,715 of new preference stock, and the 440 (Twyford) preference shares of £10 each will be converted and consolidated in one class of 5 p.ct. preference stock, to be called consolidated preference stock. For each preferred share there will be given in exchange £12 of consolidated preference stock; for each £10 of new preference stock, £10 of stock; and for each (Twyford) preference share, £12 of stock. The Company may raise by the issue of ordinary or preference stock (after taking into account premiums or discounts) £100,000; and any sum so raised may be applied to the purposes of the gas or the electricity undertaking, as the Company may determine.

The slide up or down from the dividend at the rate of 5 p.ct. per annum on the ordinary stock is to be 2s. 6d. for each one-fifth of a penny per therm increase or decrease in respect of any half-year. If in any half-year the dividend so payable on the ordinary stock comprises an amount of less than 5s. p.ct., the Directors may add the same to the reserve fund or defer payment of that amount and pay the same with the next or some succeeding dividend. The standard price for gas within the limits of supply (other than that part to which section 34 of the Order of 1924 relates) shall be 15·8d. per therm, or such other price as may from time to time be prescribed by the Board of Trade. Clauses to permit of the offering (with the approval of the Board of Trade) of stock created under the Act to the gas and electricity consumers and persons in the employ of the Company were deleted from the Bill.

The clause, which was reproduced in the "JOURNAL" for Feb. 1 last, providing for the substitution of a card index for the shareholders' address book, was removed, and the following clause substituted in the Act:

> Register of Shareholders and Shareholders' Address Book—Notwithstanding anything contained in the Companies' Clauses Consolidation Act, 1845, it shall not be obligatory upon the Company:
>
> (*a*) to keep separately a register of shareholders and shareholders' address book, but in lieu thereof the Company may, if they think fit, keep one register only containing such particulars as are required by the said Act to be entered in the register of shareholders and shareholders' address book respectively; or
>
> (*b*) to authenticate by the fixing of their common seal or otherwise the register of shareholders or any register which the Company may keep in lieu thereof under the powers of this section.

The fee for special meter readings within the Urban District of Frimley has been reduced from 2s. to 1s., but the price outside that area remains at 2s. 6d. There are provisions for the establishment of profit-sharing, and for the election of one or two Employee Directors, after the total investment of the employees in ordinary stock of the Company shall exceed the nominal amount of £20,000. The name of the Company is to be changed to "The Yorktown (Camberley) and District Gas and Electricity Company."

[*Parliamentary Agents: Messrs. Hargreaves & Crowthers.*]

NOTES ON NEW BOOKS.

LOW TEMPERATURE CARBONIZATION.*

As far as we are aware, this is the first book dealing solely with the subject of low-temperature carbonization to be published in America—upon which fact we in this country pride ourselves in being in advance of our confrères across the Atlantic. Consequently, on reading the volume by Mr. Gentry, we cannot escape the feeling that we have surveyed most of the matter previously. What we ask for in new treatises on this subject is a full consideration of the economic results of the various processes; and it is precisely in this respect that "The Technology of Low-Temperature Carbonization" falls short of our expectations. In his preface, the author states that the justification for his book rests upon its effort to treat the behaviour of coal in such a manner as to establish the art of low-temperature carbonization upon a scientific basis, so that, "henceforth, empirical methods may be reduced to a minimum;" and this statement gives a clue to the contents of his work. It does not, however, diminish in any way the value of the book to those who desire to study the fundamentals of carbonization, whether it be at low or at high temperatures; for it is a truism that many otherwise creditable efforts in low-temperature carbonization have failed because of lack of knowledge regarding the behaviour of coal and of its distillation products in respect of variations in temperature and other physical properties. Also, in studying the publication, it has to be remembered that the economic aspect of low-temperature carbonization is a restraining feature in the advance of the industry in the United States—a factor which does not apply in the same degree to countries such as Great Britain, France, and Germany, which are not so generously endowed with petroleum. This fact is mentioned by Mr. Gentry; though we have in mind that in the "JOURNAL" the other week we published an account of the rapid progress which is being made in a huge low-temperature plant on the "K.S.G." principle which is being erected for the New Brunswick Public Service Electric and Gas Company, New Jersey.

"The Technology of Low-Temperature Carbonization" is divided into eight chapters, which treat in turn the fundamentals of the subject, low-temperature gas, tar, coke, and nitrogenous and other bye-products; the various processes of low-temperature carbonization, and their operation; and finally their economics. It is the final chapter which, we think, will interest the English reader most, though, from the point of view of the student who wishes to arrive at a proper perspective of the whole question, all the sections are valuable. Concerning the economics of the process, the author observes that the sale of low-temperature tar and gas is a wholly new problem compared with the disposal of gas and tar from bye-product coke ovens or from gas retorts. The same may be said of low-temperature coke. At the same time there is bound to be a certain amount of indirect competition between them, to the extent that the price fluctuations of the products of the two different methods of coal processing can never be wholly unrelated. While there are assuredly markets for coke, gas, and oils, they are not at present markets in which any particular advantages of low-temperature products are recognized. There is a difference in the quoted prices of foundry and of furnace coke by virtue of their special properties; but there can be no reflection of special value in the price of low-temperature coke over coal as a domestic fuel until this special value is generally recognized by the consumers. In the case of low-temperature gas, Mr. Gentry suggests, the recognition is not hard to secure; but appreciation of the desirable nature of primary oils will be somewhat more difficult to obtain.

In the author's opinion, unless the cost of the raw material be unusually cheap, low-temperature carbonization can never be commercially successful in externally heated retorts operated for the sake of bye-products alone, unless there is a great advance in the market prices of these materials, relative to the raw coal. It is essential to the success of externally heated systems that the semi-coke be adequately disposed of, and almost correspondingly essential, with internally heated processes by partial gasification, that the bye-products be well marketed. The only justification for low-temperature carbonization, states the author, is its ability to show a satisfactory yield on capital.

Mr. Gentry's remarks on low-temperature tars are interesting. He observes that these have been known to vary among processes from a content of 7 p.ct. of tar acids to one of 50 p.ct., and from 40 p.ct. by volume distilled upon fractionation to a temperature of 300° Fahr. to 80 p.ct. distilled to the same degree. As far as sulphate of ammonia is concerned, this bye-product can be neglected in most instances when studying the economics of low-temperature carbonization, because of the relatively small quantities recovered in the externally-heated processes, and because of the great cost of recovery apparatus of large capacity needed with processes of the internally-heated type. In dealing with this subject, the author mentions that the cost of producing ammonium sulphate by any synthetic process now available is considerably in excess of the cost of producing the salt from bye-product coke ovens.

* "The Technology of Low-Temperature Carbonization," by Frank M. Gentry. Published by Bailliere, Tindall, and Cox; price, 34s. net.

THE CARBONIZATION OF "PARKFIELD LARGE GAS" COAL; BRISTOL AND SOMERSET COALFIELD.*

Reviewed by T. A. TOMLINSON and M. BARASH.

A particularly gratifying feature of the valuable work which is being carried out by the section of the Department of Scientific and Industrial Research dealing with the physical and chemical survey of the national coal resources is the rapidity with which detailed and comprehensive information is being made available with regard to the types and qualities of coals obtainable from various districts. Within the last few years the coals already exhaustively investigated on a large scale at H.M. Fuel Research Station include the following:

South Yorkshire	"Mitchell Main Gas Nuts" (Parkgate seam)
Durham	"Consett" "Holmside"
Lancashire	"Arley" "Ravine"
South Wales	"Meiros" (Pentre and No. 3 Rhondda seams)
Scotland	"Main and Ell" (Lanarkshire) "Kinneil Gas"

In the present report, the twelfth of the series, Dr. C. H. Lander (Director of Fuel Research) describes the work carried out under the supervision of Engineer Captain J. Fraser Shaw, Chief Engineer, and Dr. J. G. King, Chief Chemist, at the Station, on "Parkfield Large Coal," a typical gas coal from the Bristol and Somerset Coalfield. The tests were carried out at the request of the Clevedon Gas Company and the East Bristol Collieries, Ltd.

Results are given of high-temperature carbonization in the Glover-West continuous vertical retorts and in the new horizontal retort installation. The coal was also subjected to low-temperature carbonization in the setting of retorts designed at the Station, and the resultant cokes from the three processes were treated for steam-raising purposes in a Lancashire boiler, and for fuel-gas production in three types of gas plant.

The coal, of which 750 tons was used in the investigation, consisted of a representative mixture from four seams of the Parkfield Colliery, the Hard Vein (2½ ft. to 3 ft.), the Top Vein (2 ft. to 2½ ft.), and the Hollybush and Great Vein (together 5 ft. to 6 ft.). Each of the seams is stated to consist of a good and highly bituminous coal, largely used for gas manufacture and for domestic purposes in and around Bristol.

The coal consists almost entirely of clarain with thin bands of hard fusain. Analysis of a sample representing 300 tons of the above consignment showed moisture 1·5 p.ct., volatile organic matter 34·3 p.ct., ash 7·6 p.ct., sulphur and nitrogen each 1·7 p.ct., oxygen 6 p.ct., and calorific value 13,600 B.Th.U. per lb. It is rather pyritic, and consequently the ash is of a fusible nature and liable to give trouble in certain circumstances.

In the laboratory assay, the coal was found to give a swollen and porous coke, similar to that given by typical Yorkshire and Durham gas coals.

In the continuous vertical retorts the coal was carbonized under the now familiar Research Station conditions of constant throughput (2·50 tons per retort per 24 hours) and at a uniform combustion chamber temperature of 1250° to 1260° C. A special series of observations was taken for short periods to determine the gas yields obtainable without steaming, and then four to five day tests were carried out as usual under 5 p.ct., 10 p.ct., and 15 p.ct. steaming conditions. The retorts are stated to have worked smoothly on this coal except for a little trouble with "stickiness" of the charges near the top of the retorts at starting up. This difficulty was, however, readily overcome by reducing the temperature in the top two combustion chambers initially to about 1000° C.—an adjustment to which, fortunately, this type of plant readily lends itself.

In the horizontal setting four tests were carried out, each of

* Department of Scientific and Industrial Research. Fuel Research—Physical and Chemical Survey of the National Coal Resources No. 12. London: H.M. Stationery Office, Adastral House, Kingsway, W.C. 2; pp. VI. + 39, price 1s. 6d. net.

four days' duration, at a combustion chamber temperature averaging 1350° to 1355° C., corresponding to a temperature of 1100° to 1140° C. in the interior of the retorts. This setting may be heated by means of either producer gas from a built-in producer, or water gas from an independent generator. Both these systems of heating were tested, and the interesting observation is recorded that for identical combustion-chamber temperatures, with water gas heating, the inside of the retorts attained a temperature of 1050° to 1105° C., while with the hot producer gas the values were 1060° to 1160° C. The coal was worked in these retorts without difficulty or trouble during all the tests.

The following is a summary of the main results obtained from the two high-temperature systems of carbonization :

—	Test 1.	Test 3.	Test 7.
Retorts	Vertical (5 P.Ct. Steaming).	Vertical (15 P.Ct. Steaming).	Horizontal (Producer Gas Heated).
Average combustion chamber temperature	1257° C.	1260° C.	1355° C.
Coal carbonized per retort per 24 hours, tons	2·50	2·51	1·25
Yields per ton of coal—			
Coke, cwt.	13·70	13·16	14·00
Gas, c.ft.	16,030	19,200	12,930
B.Th.U. per c.ft.	511	471	568
Therms	81·91	90·43	73·44
Tar, galls.	11·5	12·9	10·4
Sp. gr. at 15° C.	1·125	1·113	1·152
Amm. sulphate, lbs.	22·8	25·8	26·7

When one takes into consideration the high-class quality of the silica material being used nowadays in the construction of vertical retort settings, and the conditions in vogue in general practice, it appears rather a pity that the Fuel Research Station should confine themselves to the comparatively low temperature of carbonization and low throughput which they have adopted as standard for the vertical retort installation. There is little doubt that such a setting could be run comfortably and successfully at the temperature carried in the new horizontal setting and at a 20 p.ct. increased throughput, particularly under the conditions of low steaming.

It is a little difficult to estimate the relative quantities of coke available for sale in the two processes. Here we have a case in which the coke from the horizontal retorts was dry-quenched. As far as we can see, there is little or no difference even when comparing the coke available for sale at 15 p.ct. steaming in the vertical retorts with that in the horizontal retorts. Usually, such comparisons are entirely vitiated by the water left in horizontal retort coke after quenching.

In the low-temperature cast-iron vertical retorts of the Station, the Parkfield coal (containing 40 p.ct. fines) could not be successfully carbonized owing to holding-up of the charge at the base of the retorts. Easier carbonization was accomplished by screening out the fines, making them into briquettes, and remixing with the large coal.

The yields of products obtained per ton of dry coal were :

Coke . . . . . 15·6 cwt.
Tar. . . . . 14·0 galls. (assuming 50 p.ct. recovery from pitch used in briquettes).
Liquor . . . . 72·0 galls. (yielding 16·3 lbs. amm. sulphate).
Gas. . . . . 10,990 c.ft., sp. gr. 0·796
= 46·2 therms, C.V. 420 B.Th.U. per c.ft.

The value of the low-temperature coke as a smokeless fuel is not indicated.

As a boiler fuel, none of the three cokes obtained by the above processes from the Parkfield coal was found to be satisfactory. The fires required careful control and continuous attention, owing to the nature of the clinker produced, which tended to stick to the fire-bars and rapidly formed a thin impervious layer over the whole grate.

Excessive clinker trouble was also experienced when it was attempted to use the cokes in the Ruston & Hornsby suction gas generator and in a Humphreys & Glasgow water gas plant. The clinker not only required excessive poking, but had a distinctly corrosive action on the generator linings.

Tested in a producer built into a retort setting, the high-temperature coke proved a suitable fuel. No trouble was experienced due to the formation of an excessive amount of clinker, and the gas produced was of normal quality.

REFORM OF THE PATENT SYSTEM.

The British Science Guild, of which Lord Melchett is President, have published a report of the Committee appointed by them in April, 1927, to consider what changes could advantageously be made in the British patent system.

A perusal of the report indicates that the Committee have endeavoured to find such amendments of the law as will have the effect of mitigating several anomalies or imperfections at one effort, rather than to design special remedies for each defect. For instance, by the institution of a short term patent several advantages would be obtained simultaneously, such as a reduction of fees for minor inventions, quicker grant, greater security against invalidity, and reduction of the existing congestion in the Patent Office. Again, the Committee's proposal that a minor tribunal should be made available for the trial of patent infringement actions would doubtless cheapen the processes of law, which in turn would alleviate certain existing forms of misuse of patents based on unworkable or unworked inventions, or containing broad and vague claims introduced among valid ones.

PRIOR PUBLICATION.

At the present time a patent is held to be invalid for want of novelty if the patentee himself disclosed the invention covered by it before applying for a patent. Such disclosures may be made in ignorance of the patent law or through failure to realize the commercial importance of what has been invented. Though the Patents Acts provide a way of avoiding to some extent the hardship thus incurred, the provision made can hardly be deemed sufficient. On this matter, the Committee offer the following suggestion : " Publication made by or derived from an inventor should in no case be pleadable against a patent subsequently granted to that inventor, provided that the patent was applied for within twelve months after such publication."

According to the present system, the Patent Office makes a search through the relevant British specifications before granting a patent, and brings to the applicant's notice any anticipations which it may find in this way. The Committee are of opinion that this search should no longer be restricted to British specifications, but should be extended to other relevant documents.

SUBJECT-MATTER OF A PATENT.

On the question of subject-matter, the Committee hold the view that the Courts, in deciding upon the presence of subject-matter in any particular instance, ought to give favourable consideration to an alleged invention which has arisen from prolonged and meritorious research work even on a laboratory scale. At present, of course, a patent cannot be valid unless the invention adds to existing knowledge something more than a skilled workman could have been expected to produce by a mere application of the rules which he was taught in the course of his training.

An invention may be thought of in a flash of intuition by a man of genius in the unquestionable exercise of inventive ingenuity, or it may be arrived at as the result of systematic research by a scientific staff, working along lines which would naturally suggest themselves to scientific men having an adequate knowledge of their subject. It is difficult, however, to draw a clear distinction between such a process of research on the one hand, and the use by a skilled workman of the known rules of his art on the other. It has been strongly represented to the Committee that, if the term " skilled workman " be applicable to trained scientists employed by industrial concerns with the definite intention that their work shall lead to industrial improvement, and if the scientific principles and technique that these men have acquired during their training and work have the legal status of the known rules of an art, then nothing that results from the work that such scientists are paid to perform can contain legal subject-matter or constitute a patentable invention. Thus, while the growth of industrial research is full of promise for British industry, and should by all means be encouraged, there is a fear in the minds of some research workers that the validity of patents for research inventions may be imperilled by the circumstances of their origin. Whether this fear be warranted or not, it should be removed. The matter can best be dealt with, not by statutory enactment, but through a clear recognition on the part of the Courts of the new importance which has been assumed by industrial research.

On another point, the Committee think it desirable that the interpretation of the word " manufacture " should be extended so as to permit of the patenting of a wider range of biological inventions.

SHORT-TERM PATENTS.

One of the most interesting sections of the report is concerned with short-term patents. Monopolies in several different categories are granted in this country for different types of industrial and intellectual property—namely, trade marks, literary works, designs characterized solely by their visual effect, and inventions. Intermediate between the last two there is a type of innovation for which no suitable protection is provided; and a need has long been felt for the institution of a new category of protection analogous to the German Gebrauchsmuster. This would be intended primarily to encourage the production of designs characterized not by their visual effect but by their utility. The articles to be protected

would include, for instance, utensils, tools or machine parts of novel and convenient shape, and machines of known type having a novel lay-out of component parts. The existing patent system, the Committee state, is frequently used for protecting such designs, but is inappropriate for the purpose.

They therefore advocate the institution of short-term patents, which ought not to be "liable in the same degree as full-term patents to invalidation on the ground of 'lack of subject-matter;' it should generally be sufficient that the innovations protected by them be new and useful." In this way, it is observed, adequate protection would be bestowed on innovations which merit a limited monopoly, but cannot with any security be protected by ordinary patents. It is also desirable that the grant should be prompter and cheaper than is practicable with full-term patents, since the type of innovations to which the new system is particularly adapted is one for which quick sales are often essential.

Trial of Patent Actions.

Considerable attention is paid to the trial of patent actions before the Comptroller. At present a patentee can enforce his rights only by bringing an action for infringement in the High Court. The costs in such actions are often heavy; and where the issues are comparatively simple, a cheaper form of litigation is desirable. Though access to the High Court ought not to be closed in any instance, it may often happen that both parties to an action would be satisfied with a less expensive tribunal. The County Courts are unsuitable for patent proceedings, but the special knowledge and experience of the Patent Office suggest that its services should be utilized for this purpose.

Many other considerations are dealt with in the report, which, published at the price of 2s., is obtainable from the British Science Guild, 6, John Street, Adelphi, W.C. 2.

DOMESTIC COKE.

By M. BARASH, M.Sc.(Tech.), A I C.

In the "JOURNAL" for June 2, 1926, pp. 462-63, was published a short abstract of a piece of valuable research work carried out at the Massachusetts Institute of Technology, Cambridge, Mass., on the value as a domestic fuel of coke from Glover-West continuous vertical retorts compared with oven coke, horizontal retort coke, and anthracite. It was there shown that for ease of ignition, efficiency of combustion, and the period during which the fire remained alive without attention, the continuous vertical coke was superior to each of the other fuels.

These conclusions are supported to a convincing degree in a copy of a publication from an authoritative and independent source, which has just come to hand. This is a supplementary report of tests carried out for the U.S. Bureau of Mines by Mr. P. Nicholls, the Supervising Engineer of the Fuel Section of the Pittsburgh Experimental Station of the Bureau. An exhaustive investigation is being pursued at this station into the properties of bulk samples of coke prepared from Pittsburgh coal under ordinary working conditions in a series of installations consisting of two types of intermittent vertical retorts, ovens, horizontal retorts, and two types of continuous vertical retorts, one of which is the Stamford installation of Glover-West retorts. A Continental beehive coke was also examined, and the results are included for comparison.

The methods of testing and the results obtained are given in considerable detail. From them the following summary has been culled as showing the relative properties of the cokes for domestic use. The analysis of the Stamford coke shows it to be of a fairly representative quality, differing in chemical composition from the other cokes only to the extent that on air-drying it gave no loss of moisture, its hydrogen content (0·7 p.ct.) was somewhat higher than that of any of the other cokes, and it contained no oxygen, whereas in the others this ranged from 0·2 to 1·2 p.ct.

Chemical Analysis.

	P.Ct.
Moisture, air dried	0·0
Proximate, moisture free—	
Volatile matter	1·6
Fixed carbon	88·4
Ash	10·0
Sulphur	0·7
Cal. value (dry)	12,860 B.Th.U. per lb.

Grading Test.

[Average of tests on three samples of 200 lbs. each.]

	P.Ct.
Over 1 in.	79·2
Between 1 in. and ½ in.	9·9
Below ½ in.	10·9

Both the cokes from the continuous verticals were of the same average size—larger than the average size of the coke from the intermittent verticals, and smaller than the other cokes.

Specific Gravity.—The Stamford coke is shown to have the lowest true specific gravity—1·77, as against 1·84 for the intermittent vertical coke, the next highest—and the highest percentage of cell space. These are valuable characteristics with regard to the properties of ignitibility and combustibility of domestic coke, to which reference will be made later.

Absorption and Retention of Water.—These tests were an attempt to duplicate the weather conditions to which a coke for domestic use (size 1½ in. to 1 in.) might be subjected. The results obtained (indicated here for the Stamford coke only) showed that the final percentage of water retained in the Stamford coke was lower than that in the coke from the horizontal retorts, and was about the same as that from the intermittent verticals.

	P.Ct. Water of Dry Coke.
After 1st wetting	4·17
,, ,, standing	3·66
,, 4th wetting	6·95
Final retention	5·82

Tests for combustibility, ease of starting fire, and time a firing lasts were carried out by burning the cokes in a circular furnace of 1 sq. ft. area and 26 in. fuel depth. A constant supply of air to the ash-pit was maintained, and fresh coke added at short intervals so as to keep a uniform fuel bed. All cokes were sized to 1½ in. to 1 in. square mesh; no air was supplied over the fuel bed; continuous analyses were taken of the flue gases; and conditions of testing and manipulation were, of course, kept standard for all the fuels. It is stated that the tests were conducted with great care, and that the results obtained are reliable.

It was found that the Stamford coke burned the first 6 lbs. more quickly than any other—in 1·2 hours, against 1·4 hours for the other continuous vertical coke, which was the lowest of the other cokes. This test is given as showing an approximate measure of the ease of starting the fire; the shortest time indicating the greatest ease of lighting.

The quantity of unburned fuel remaining in the fuel bed when the fire died out is taken as a measure of its ability to keep alight; the coke giving the lowest figure being the one which will give the longest fire without attention. This item is given for the Stamford coke as 4·9 lbs., which is the lowest of all the cokes; the next being 6·1 lbs., for the other sample of continuous vertical retort coke.

The report states that a fuel which leaves little combustible matter under the above conditions would also be expected to ignite easily. The general agreement of the order in which the different cokes fall with regard to "starting the fire," and the latter test, support this conclusion. Both lists confirm the fact that the Stamford coke is the most easily ignited of all the cokes tested.

From two interesting tables giving the results of the tests in detail, the following chief items are reproduced. Where possible, the comparison is made on a "per cent. ratio" scale—that is, the coke having the highest numerical test value has been assigned 100 p.ct., and the others proportioned downwards.

Summary Comparison of Certain Properties of 1½ in. to 1 in. Screen Cokes.

Property.	Scale of Comparison.	Cokes from—						
		Intermittent Verticals.	Ovens.	Intermittent Verticals. New Type.	Beehive (Continental).	Horizontal Retorts.	Continuous Verticals.	Glover-West Continuous Verticals.
Weight per c.ft.	P.ct. ratio	100	99	98	98	88	70	73
Number of pieces per c.ft.	,, ,,	93	89	93	85	82	84	100
Ease of starting fire	100 p.ct. easiest	68	64	77	80	70	82	100
Time a firing lasts	P.ct. ratio	100	98	96	98	86	64	54
Oxygen average in flue gases	Actual p.ct.	3·6	3·0	2·6	4·2	2·7	1·8	1·9
Average temperature of flue gases	Degrees Fahr.	746	768	780	800	766	813	729
Unburned combustible in refuse	P.ct. ratio	100	91	84	89	78	64	50
Combustibility and reactivity in air	Order of values	6	3–4	3–4	7	5	2	1

RATIONALIZATION IN GAS-WORKS.

By ERNST KÖRTING, of Berlin.

Rationalization, a term now frequently met with in the English language, owes its origin, we believe, to Germany, and particularly to the period of economic recovery from the effects of the war. At this year's meeting of the German Gas Association, Herr Körting described something of what has been done in the gas industry in that direction. The following are some of the points from his paper, which was published in "Das Gas- und Wasserfach," Sept. 8, 1928.

Rationalization may be described as the adoption of all possible means conducive to an improvement in the relationship between expenditure and income. It goes further than scientific management, as it is possible to conduct a business scientifically without commercial success. On the other hand, rationalization is hardly possible without the adoption of scientific methods, not only as regards the purely technical side, but also in the collection and application of data of all kinds, both technical and commercial, and a right understanding of basic principles. Times have changed indeed since the days of a certain gas engineer whom Herr Körting once knew, whose entire working results revolved round the one unalterable rule that his settings required only 10 p.ct. firing; or another who worked his plant entirely without governors, because somewhere or other an explosion had occurred in a governor house.

THE CONSERVATISM OF THE GAS INDUSTRY.

All the same, when he came to examine the gas industry from the rationalization point of view, Herr Körting was forced to the conclusion that in the last hundred odd years little or no change has been made in its basic process—viz., the dry distillation of coal at high temperatures. Has this conservatism been justified? Or should the industry have yielded long ago to one or all of the many proposals made from without in the direction of radical changes. Different as they are from one another, the alternative processes all have one feature in common. They aim primarily at the production of some other valuable commodity, and regard gas as the by-product. Some of them offer oils and smokeless fuel, for which no one will pay the price; some envisage ammonia as the primary product; the coke ovens, again, lay stress, above all, upon good coke. They all have much in their favour, and at different times each may be able to justify its own claims. But they all lose sight of one of the main tendencies of the modern economic system—unlimited expansion in any direction which offers prospects of an immediate profit, with inevitable early saturation. Synthetic ammonia prospers to-day. But how long will it do so, with plants springing up like mushrooms everywhere? And in this respect the gas industry has been justified, in that all along it has concentrated upon the production of gas and coke, and has found a market for both.

WHAT HAS BEEN ACHIEVED.

Rationalization, as far as the dry distillation process is concerned, has applied primarily to the raw material. The coal industry, faced with increasing competition, has seen itself compelled to give better attention to preparation and grading of its deliveries. The gas industry, by thorough scientific investigation into the subject, has discovered much as to the selection of suitable coals, and as to the possibilities of blending. In these ways, it has been possible to counteract practically the whole of the increased coal prices as compared with pre-war. In Berlin, in fact, the works do not pay a higher price per ton to-day than in 1914, and the improving tendency of coal quality is well illustrated by the fact that, in 1926, only 10,000 tons of small coke had to be disposed of, as against 90,000 tons in 1922.

Another direction in which rationalization has worked is towards improvement in gaseous yields, whether by carbonization at higher temperatures, or by steaming in verticals. Then, again, much has been done towards a more economical use of the heat in the settings and the water gas plant. Herr Körting does not include in this the substitution of individual by central producers, of the advantage of which he is by no means convinced. But a great deal has been saved by the introduction of waste-heat boilers, and by a judicious regulation of working methods according to the state, from time to time, of the coke market. In the latter category he includes what he terms a feature of English practice—always to use a considerable proportion of carburetted water gas, even when this is at times more expensive than coal gas. The difference, he estimates, is recovered again and again in the effect it has upon the coal and coke markets.

SOME RESULTS OF RATIONALIZATION.

The effect of this more "rational" working has indeed been striking in the aggregate. The coal consumption, for instance, at the author's Berlin Works was, for approximately equal outputs, 472,000 tons in 1913, and 321,000 tons in 1927. Coke disposals were 214,000 tons against 138,000 tons. Gas makes per ton, in cub. metres, were: 1913, 345; 1922, 382; 1923, 425; 1924, 468; and 1927, 504; and in the current year it will be considerably higher, as they have had to give up benzole production. These figures clearly indicate the great improvement which has been effected in the matter of coal. The net coal consumption—viz., coal consumption *less* coke consumption—per 100 cub.m. of gas was reduced from 150 kg. in 1913 to little more than 100 kg. in the modernized plant of to-day.

LABOUR AND UPKEEP COSTS.

One of the principal objects of rationalization must always be the improving of the efficiency of machinery, and a corresponding reduction of labour costs. This can, of course, be best achieved when planning entirely new works, but much can also be effected by re-organizing existing ones. In Berlin to-day, 5 men are employed per million cub.m. per annum, against 6·25 in 1913 [0·14 against 0·18 per million c.ft.], in spite of the reduction of working hours to eight, and the granting of a summer holiday. Technical improvements and the better distribution of consumption over the whole year have, of course, contributed largely to this result, but the author has been surprised at the economies effected by a vigorous campaign in departments outside the actual manufacture of gas. There are, for example, certain fittings and parts which can, possibly, be made more cheaply at the works than they can be bought outside. But the making of them occupies only part time, and work on something else must be found for the men. It is remarkable how easily such work always is found—or made! A problem in this connection is the question of painting. Is a staff of painters to be maintained, year in and year out? No work, in Herr Körting's opinion, is harder to control, or more likely to lead to waste. Or are contracts to be let for big jobs at a time—a retort house, a holder, or an overhead conveyor? In this case he considers one is far too much at the mercy of the contractor. He himself has adopted something of a compromise, which proves quite satisfactory, in that he employs, by time, the workmen of a painting firm under the supervision of his own staff, and does a part of a holder, or whatever is strictly necessary, without undue regard to æsthetic results.

Then there are many ways in which the engineer can save by applying rationalization methods to his repairs. Modern retorts have attained a life of 4000 carbonizing days, against only 200 in 1895. Coke quenching methods are constantly being improved. By suiting the dimensions of the purifiers to the composition of the gas, they can be made to function for years without emptying and refilling. Taking all modern advances into consideration, Herr Körting considers that upkeep costs should not exceed a figure of 0·8 pfennig per cub.m., or about 2·7d. per 1000 c.ft.

THE FUTURE.

The result of all these improvements is considered eminently satisfactory. In spite of losing the income formerly derived from ammonia and benzole, and in spite of increases in salaries and wages in even greater proportion than the rise in the cost of living, gas can be delivered into holder at very little more than the pre-war cost. Gas prices could be reduced were it not for an impossible burden of taxation, and the fact that distribution and administration have not yet been subjected to rationalization. Apart, however, from extensions of the automatic street lighting system, there appears to be little that can be done to improve matters in these categories, unless the cost is thrown directly on to the consumers. In Hamburg, for instance, the gas undertaking merely acts as adviser, and leaves interior piping and apparatus entirely to private firms. And yet the consumption there has developed better than in the author's undertaking in Berlin, which is of about the same size, and which employs 500 maintenance men at a cost of about 3d. per 1000 c.ft. He contrasts the system also with the development in recent years of free maintenance in England.

With all modern ideas incorporated, Herr Körting considers that a gas-works could be erected to-day at even lower cost than in pre-war days, in spite of a 60 p.ct. increase in material and wages. Coal storage and handling are considerably reduced by modern carbonizing methods. Retort houses are largely replaced by water gas plant. Extraction of cyanogen and benzole can be omitted entirely, and ammonia recovery is no longer required. Cooling and ammonia extraction can therefore be combined in one process of direct contact with water, and standard scrubbers are not necessary. Purifiers can, as in Vienna, be constructed in the open air.

The position of the gas industry to-day, in Herr Körting's opinion, with its basic process of dry distillation of coal, and a continued application to all its branches of the principles of rationalization, is sounder than ever before. His optimism, as regards Germany, is tempered only by the intrigue and interference in connection with coke-oven gas supplies, which constitute a serious menace to the successful gas undertakings which are serving the nation so well.

BIG RECONSTRUCTION SCHEME AT SMETHWICK.

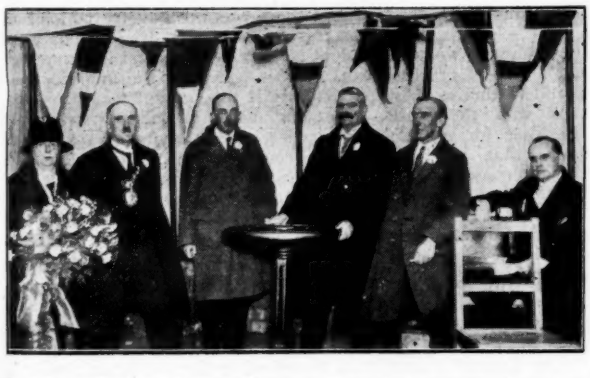
COMPLETION OF A 3½ MILLION C.FT. SPIRAL-GUIDED HOLDER.

Upon his appointment in 1920 as Engineer and Manager of the County Borough of Smethwick Gas Department, Mr. Ernest Hardiker, F.C.S., was instructed to prepare a scheme for the reconstruction of the works, in order to cope with the ever-increasing demand for gas; and in 1922 his proposals were adopted by the Gas Committee. The result has been the carrying-out of work, just completed, bringing up the productive capacity of the works from about 3½ to 5 million c.ft. per day on the same area. Further storage capacity has also been provided, in the form of a 3½ million c.ft. spiral holder. An account follows of the new holder and reconstructed works, which were inaugurated and officially inspected last Wednesday. The scheme will result in a large saving of money annually.

In a tent which had been erected for the occasion, the ceremony of inaugurating the new holder took place—Mr. S. W. B. Stephen, J.P., opening the outlet valve, which allowed the gas to pass from the holder to the town supply mains. The MAYOR (Alderman A. T. Morris, J.P.) having made a few introductory remarks,

INAUGURATION OF THE NEW HOLDER.

Mr. S. W. B. STEPHEN said he had had some little to do with gas matters in years gone by, and he took it that this was why he had been asked to perform the ceremony that day. Not only was this a development of the gas-works, but it was a development of the town. There had been an ever-increasing demand for gas in the district. From 1882 to 1920, the output had multiplied approximately six times. This growing business in time rendered it essential to provide additional storage, and as a matter of fact the project was not started a moment too soon. He thought the decision to erect a spiral-guided holder was a wise one. The advantages of this design were obvious—one of the most important being the question of cost. When it came to the subject of drawing-up specifications for the holder, the Committee found they had in their service a young man, as Engineer, who was capable of taking the full responsibility for these. They took the precaution of calling in Mr. W. Doig Gibb, the eminent Consulting Engineer (whom



Mr. S. W. B. Stephen, J.P. (Ex-Chairman of the Gas Committee), turns on the Gas from the New Holder to the Town.

he was pleased to see present), to look-over the plans; and it was exceedingly gratifying to know that the original specifications, as drawn up by Mr. Ernest Hardiker, were passed by Mr. Doig Gibb in their entirety. Another big question, of course, was the makers to be entrusted with the construction of the holder; and after considering offers by the best firms in the industry, the tender was awarded to Messrs. R. & J. Dempster, Ltd., of Manchester, who had done their work exceedingly well. The recent heavy gales had tested the holder severely, and it had stood up to them most satisfactorily.

Referring to the original Murdoch holder at Smethwick, Mr. Stephen remarked on the fact that the extraordinary time the plates had lasted was eloquent testimony to the quality of the wrought-iron sheeting of that day. He added that he thought it was a great pity the gas industry did not, when the chance arose, take steps to preserve that holder, and put it into good condition again. In missing the opportunity, the industry was lacking in vision. He did his best at the time to try to get the holder preserved, but was unsuccessful, and he believed that it had now fallen completely into decay.

In conclusion, he congratulated the Committee and the town on the completion of the new spiral-guided holder, which had placed them in a much safer condition from the point of view of gas supply than they had been in for many years past. He trusted the provision of this holder would result in a reduction of unemployment in the town by the supply of cheaper gas, which he regarded as a distinct possibility. Mr. Stephen then turned on the valve, wishing prosperity to the gas undertaking, and expressing the hope that the Corporation might for many years retain the services of their Gas Engineer.

The MAYOR proposed a vote of thanks to Mr. Stephen, who, he mentioned, was at one time Chairman of the Gas Committee for a period of three years.

Councillor W. J. SALMON seconded the vote, and made reference to the great services rendered to the undertaking by Mr. Hardiker.

MEMORIAL TABLET TO MURDOCH.

There followed the ceremony of unveiling a memorial tablet to Murdoch. The tablet is placed at the top of a flight of steps to the new holder; and the unveiling was performed by Mr. A. W. Smith, General Manager and Secretary of the Birmingham Corporation Gas Department.

Mr. A. W. SMITH said that in the first place he would like to express his appreciation of being allowed the honour of taking part in this ceremony. He looked upon it as a special honour, because it was certainly unusual for an official of a neighbouring authority to be asked to undertake a duty of this kind. He assumed that it was an expression of the very friendly relationship that had always existed between the respective gas undertakings. Birmingham, by its purchase of the Gas Companies in 1875, made it possible for Smethwick to take over its own gas supply; and he would remind those present that Birmingham supplied them with their first Gas Engineer (Mr. B. W. Smith), who was previously employed at the Saltley Gas-Works. Mr. L. Thomas, the Assistant Gas Engineer at Smethwick, was also trained at Birmingham.

He congratulated Smethwick upon the tremendous expansion of its activities since those early days. He noticed that the amount of gas sold was more than seven times greater in the last year than in the first year of the undertaking. This was a phenomenal increase, and reflected credit upon those who had been responsible for the management and administration of the undertaking. The Birmingham and Smethwick gas undertakings had both been equally fortunate in being able to attract as Chairmen and members of their Gas Committees experienced business men, who had devoted their time and abilities to furthering and developing this essential service to the community. The general public were little aware of the great debt they owed to such men; for however able an officer one might have as engineer or manager, the success of the undertaking depended to a very considerable extent upon the policy dictated by his chairman and committee. The engineer was indeed fortunate who had behind him the support of men of such ability as Alderman Pinkney, Councillor Stephen, and the present Chairman at Smethwick, Alderman Williets.

He would like also to congratulate Smethwick upon their desire to do honour to the name of Murdoch by the unveiling of a memorial tablet. He remembered the endeavours that were made—unfortunately unsuccessfully—by Mr. Stephen to preserve for posterity the old house of Murdoch, which had now been demolished. Sentiment played a large part in all their lives; and when one realized—as those of them engaged in the industry must do—the tremendous debt that the nations of the world owed to Murdoch through his practical development of the distillation of coal, it seemed very regrettable that the residence in which he did so much of his pioneer work was allowed to fall into disrepair, and ultimately to be demolished. This was forcibly brought to his mind by a visit he had last year from two Japanese Gas Engineers, who came to Birmingham, partly to inspect the gas-works, but principally as a pilgrimage to the shrine of Murdoch. The major part of their stay in Birmingham was devoted to visiting places associated with the originator of the gas industry; and a delightful touch was given when they were taken to Handsworth Church (where Murdoch was buried), by their calling on the way at a florist's shop and purchasing a wreath, which they placed before the bust there. It struck him then that they were being taught by the younger commercial nations of the world the debt they owed to William Murdoch. The importance of his work was not realized in his day. In fact, as those present were probably aware, gas lighting ran the gauntlet of much criticism in its early years—criticism inspired to some extent by vested interests in the whale oil industry, though strangely enough the most vituperative criticism came from the pulpit. It was evidently considered to be sacrilegious to attempt to throw light into dark places by the lighting of streets and houses with this new illuminant; and it was on record that many clergy throughout the country protested against gas lighting as being profane and contrary to God's law. They had travelled far since those days, although he was afraid vested interests still had an influence in attempting to retard the development of

UNVEILING OF THE MURDOCH MEMORIAL TABLET

by Mr. A. W. Smith, General Manager and Secretary of the Birmingham Corporation Gas Department.

[From left to right: The Mayor of Smethwick (Alderman A. T. Morris, J.P.) and the Mayoress; Alderman A. M. Williets, J.P., Chairman of the Gas Committee; Mr. Ernest Hardiker, F.C.S., Engineer and Manager; and Mr. A. W. Smith.]

new ideas. Strange as it might appear, the gas industry still suffered from that distrust which prevailed at its birth. It was still shackled with legislative measures dating back to 1847 and earlier.

The gas industry had, as they knew, recently been endeavouring to persuade the Board of Trade to bring in a measure which would modernize legislation, and place it on an equal footing with competitive industries; but although no one, as far as he was aware, could gainsay the justice of their cause, the difficulty in the way of granting what they asked for would appear to arise from the innate conservatism of the politicians, and, he was afraid, of the Englishman generally, in not desiring to interfere with long-established practices. However, they were hopeful that they might induce the Government at an early date to give the gas industry the modern commercial powers for which it justly asked. Given such powers, he could foresee that ere long there would be such a "rationalization" (to use the modern word) of the industry as would make for greater service to the community and development without parallel in its previous history. Their contributions, as an industry, to the amenities of life read like a romance; for Murdoch "builded better than he knew." In whatever direction one turned, there was to be seen the influence of the great gas industry which he founded. Gas lighting enabled roads to be traversed with safety, students to study, and doctors and surgeons to perform their beneficent deeds with greater certainty. The internal combustion engine of the motor car developed from the gas engine. Tar, with its 2000 derivatives, and other residuals, entered into practically every industry in the country. The tarring of roads made motor traffic possible; and, in fact, he knew of no activity of human life at the present time in which gas, either directly or indirectly, did not have some influence. It was with these thoughts in mind that he had pleasure in unveiling the tablet to William Murdoch.

The inscription on the tablet reads:

> "1798—1808. William Murdoch. Instituted gas lighting on a practical scale at Messrs. Boulton & Watt, Soho Foundry, Smethwick, where he erected a cylindrical gasholder (195 yards from this spot) which is still in existence, 1928."

TEA AND TOASTS.

The inspection of the gas-works was followed by tea in the spacious canteen of Morris Commercial Cars, Ltd.; and after this there was some speech-making.

Alderman A. M. WILLIETS, J.P. (the Chairman of the Gas Committee), remarked that there was present a gentleman for whom they had great regard, and who played a very important part in connection with that undertaking, during a period of extreme difficulty—Mr. Vincent Hughes. During the war years Mr. Hughes was in charge of their undertaking, suffering from the restrictions, the restraints, and the disabilities which all undertakings experienced at that time. Smethwick owed a debt of gratitude to him; and they were delighted that he was associated with them at that auspicious event. Coming to the scheme of reconstruction, the Chairman emphasized the fact that all had been done while there had been increasing demands upon the undertaking. This necessitated careful organization on the part of Mr. Hardiker, and also on the part of the foremen and workmen in each department of the undertaking. The total cost of the scheme had been nearly £250,000, of which £63,624 had been met out of revenue—a fact which spoke volumes for their undertaking. They had also had assistance from the Unemployment Grants Committee.

Alderman C. W. PINKNEY, J.P., submitted the toast of "The Gas Industry." He said that there was no industry which had a more scientific Press than the gas industry. Its journals were such that the weakest student could gather correct information, and a basis for future work. This being so, the industry was bound to thrive, more particularly if the student would put his back into the work. He had been associated with Mr. Hardiker for a number of years, and had not the slightest doubt that he had not yet reached the zenith. To Mr. Hardiker and all engaged with him, he wished great success in the future development of the undertaking.

Mr. W. G. S. CRANMER, J.P. (President of the Midland Association of Gas Engineers), responded to the toast, and congratulated Smethwick upon the great progress they were making in regard to the gas undertaking.

SMETHWICK GAS-WORKS DEVELOPMENT.

The County Borough of Smethwick figures prominently in the history of the gas industry in this country. It was in 1798 that William Murdoch, the originator of gas lighting, removed from Redruth, Cornwall, to Messrs. Boulton & Watt's Soho Foundry, Smethwick, whose works are still in existence, and form part of the larger premises of Messrs. W. & T. Avery, Ltd.; and he there further developed his experiments in the gas process.

Smethwick originally formed part of the district supplied by the Birmingham and Staffordshire Gas Light Company, which covered an exceedingly large area. In 1875 the powers of this Company were purchased by the Corporation of Birmingham, at which time a clause was inserted in the Bill enabling the outlying districts (subject to arbitration) to erect works for themselves. After lengthy proceedings Smethwick, West Bromwich, Oldbury, and Tipton availed themselves of this privilege. The purchase price of the undertaking amounted to £56,090, and the Smethwick Works, erected at a cost of £49,000, were opened on Oct. 1, 1881.

The erection of the works was commenced on the present site in 1877, and by December, 1881, the undertaking, of which Mr. B. W. Smith was first Engineer, had so developed that it was necessary to instruct Sir F. Bramwell to prepare plans and specifications for the erection of additional plant, for which sanction was obtained to borrow the sum of £75,000. In 1882 the gas made amounted to 123,693,000 c.ft. The corresponding figure for 1928 was 905,946,500 c.ft.

In 1892 the sales of gas had so increased that it was found imperative to make provision for greater productive power, and the old direct fired retorts were replaced by an installation of Klönne regenerative furnaces, bringing the capacity of the works to 1½ million c.ft. per diem, without leaving any margin for breakdown. The rapid growth of the town, coupled with the improvement of trade and the introduction of the prepayment meter system in 1898, rendered further extensions of plant

again necessary; and the retort house was further extended to permit of the erection of four beds of inclined retorts. In this year the first exhibitions and demonstrations of gas cookers and heating apparatus were held in the town by Messrs. Parkinson & Co. and the Cannon Hollow-Ware Company.

The works were further extended to meet the growing demand for gas by the installation of the carburetted water gas plant, supplied by the Economical Gas Apparatus Construction Company, Ltd.; and shortly afterwards this plant was duplicated—the combined water gas capacity being one million c.ft. per diem. By the year 1910 the consumption of gas had again outgrown the capacity of the works; and after very careful investigation into the relative merits of coke ovens and horizontal and vertical carbonizing systems, it was decided, after taking into account the restricted area of the site, to replace the existing retorts by an installation of Duckham & Cloudesley vertical retorts, which was one of the first of this system to be erected in this country. The installation was duplicated in the year 1913.

The present Engineer, on his appointment in 1920, was instructed to prepare a scheme for the reconstruction of the works, to cope with the increasing demand for gas, which by this time was steadily gaining favour for industrial purposes. The report was adopted by the Gas Committee and Council in March, 1922. The main provisions were: The acquisition of land, adjoining the works, and the erection thereon of a 3½ million c.ft. capacity spiral-guided gasholder and mass concrete tank. [The existing storage accommodation of 1,200,000 c.ft. was totally inadequate to deal with the requirements of the town; the maximum daily consumption of gas having risen to the neighbourhood of 3 million c.ft. per diem, which has since further increased to 3¾ millions.] The re-modelling of the carburetted water gas plant, thereby increasing the capacity from 1 million to 1¾ million c.ft. per diem. The reconstruction of the installation of vertical retorts, increasing their capacity from 2¾ million to 3½ million c.ft. per diem, including the provision of waste-heat boilers, coal wagon tipplers, breakers, coke conveyors, and auxiliary equipment. The substitution of an electrical mono-rail telpher coke conveying plant for the existing conveyor of the drag type, which had become obsolete. The installation of additional purifiers and oxide handling plant. Among other additions provided for were: Electricity generating plant, new works stores, and enlargement of works and distributive mains.

The Ministry of Health granted powers to raise the necessary capital, and the work, commenced forthwith, has just been brought to successful completion. The total capital expenditure at March 31, 1928, was £474,913. The loans outstanding amounted to £247,605; the net debt being £231,447. The number of meters in use has increased from 1995 in 1881 to 16,314 at March 31, 1928. The area of the gas supply at March 31 last was 1929 acres, which has since been increased to 2500 acres by the acquisition of a portion of Warley from the Oldbury Urban District Council.

Carbonizing Plant.

The Gas Committee early recognized the advantages of continuous vertical retorts, and in 1911 placed a contract with Messrs. Duckham & Cloudesley, Ltd., for the erection of six settings of 24 retorts on the Woodall-Duckham principle. In 1914 another 32 retorts were added; and these have been re-set (sixteen in silica). The producers are fitted with step grates. The coke discharge doors are not of the usual Woodall-Duckham pattern, but have been specially designed by the Department. Four Reavell-Askania regulators are used to control the vacuum on the retorts.

The coke is discharged from the retorts into skips of about 1 ton capacity, which are lowered into small chassis, and traversed by manual labour to the end of the retort house. A mono-rail telpher constructed by Messrs. Robert Dempster & Sons lifts the loaded skips from the chassis and conveys the coke to the retort house hopper, screening plant, water gas plant, or storage yard. The coke is passed through a rotary wire mesh screen; being separated into large coke, nuts, breeze, and dust.

The luteless purifiers fixed upon a superstructure comprise six cast-iron boxes 35 ft. by 30 ft. by 6 ft. deep inside, with division plates, valves, connections, sub-structure, roof, and oxide handling plant. The latter consists of four "Bearscot" friction hoists which run over the centre of the boxes. Provision has been made for the extension of the installation to eight purifiers.

Water Gas Plant.

This was originally built in 1899 under the Merrifield, Westcott, Pearson Patents; and in 1922-23 was reconstructed by Messrs. Davison & Partner. The plant consists of two sets, each capable of making 800,000 c.ft. of carburetted water gas per diem, complete with scrubbers, condensers, relief holder, exhausters, blowers, purifiers, and boilers. The stream of water gas mixes with the coal gas at the inlet to holders.

In connection with the vertical retort installation, there are two Woodall-Duckham waste-heat boilers of the horizontal fire-tube type. They are fitted with superheaters, and exhaust fans driven by DeLaval steam turbines. Adjoining the coal gas exhauster house are two Lancashire boilers fitted with Crossthwaite furnaces. The two Lancashire boilers on the water gas plant are fitted with "Turbine" furnaces for using low-grade fuel.

Electricity Generating Plant.

Electric current at 220 volts D.C. is generated on the works. The plant comprises a 120-KW. British Thomson-Houston dynamo driven by a Sissons double-crank forced lubrication compound engine; a 60-KW. Crompton dynamo driven by a Tangye Archer engine; and a small lighting set with a Crompton dynamo and Tangye Archer engine.

There is a water softening plant by the Kennicott Water Softener Company, Ltd.

Distribution Workshops.

The Committee have purchased land at the corner of Crocketts Lane and Piddock Road, where the building of large up-to-date premises will be commenced in the near future. The new premises will be centrally situated in the town and will form a very comprehensive and up-to-date distribution station, including under one roof commodious stores, fitters' assembly hall, cooker and meter repair shops, garage, mess rooms, basement stores for large apparatus, and cost control offices.

In addition to the foregoing an industrial appliance demonstration room is being provided to cater for the requirements of the industrial users of gas, where heat-treatment appliances of all kinds will be on view for demonstration purposes. This room will be suitably equipped with pyrometers, meters, and other instruments, and will be set aside for the use of consumers.

The Department have a showroom on the main thoroughfare, at 261, High Street, where domestic appliances and fittings are on view. The Committee are, however, contemplating the erection of a new building on land within a few yards of the present showroom, to be designed and laid out on modern lines.

Gasholder.

The holder has a capacity of 3½ million c.ft. The first sod was dug by the then Chairman of the Gas Committee, Councillor S. W. B. Stephen, J.P., on March 26, 1924. The tank, which is of concrete with steel bands and brick facing, is 187 ft. 6 in. in diameter, and 37 ft. 6 in. deep. It was constructed by Messrs. Thos. Vale & Son, Ltd., of Stourport. The contract for the holder, which is of the spirally guided type, and has four lifts, was entrusted to Messrs. R. & J. Dempster, Ltd., of Manchester. The inner lift is 176 ft. 9 in. in diameter, the second 179 ft. 6 in., the third 182 ft. 3 in., and the fourth 185 ft. All are 36 ft. 6 in. deep. The pressure thrown by the inner lift is 50 tenths.

The holder embodies the latest improvements in modern practice. The crown of the inner lift has a rise of 12 ft. 6 in. above the level of the top curb, and Livesey manholes are fixed over the inlet and outlet pipes. The trussed crown framing is of the latest design, and the main and intermediate rafters are secured to the secondary curb and vertical stays. Thereby the riveting and roof construction are considerably simplified. The circular rings of angle iron forming the roof purlins are secured to the upper surface of the various roof bars, to support the crown plating. The upper ends of the vertical stays are kneed and secured to the underside of the dip, to prevent the dip channel being distorted when carrying the weight of the lifts. They are also extended at the lower end, and bracketed to the underside of the cup channels, to prevent distortion. The top row of side plates on the various lifts is extended above the curbs and above the dip channels, to protect the painting; the water flowing from the crown or cups down the spiral rails, instead of spreading over the whole surface of the sides.

To receive the ends of the spiral rail plates, provision is made on the top and bottom rows of side plates; thereby avoiding the thinning of the plates and lap joints at the curbs and also at the cups and dips. The 112 guide carriages are of the "Bearscot" 4-roller type, and the dip carriage rollers are linked in pairs, on opposite sides of the guide rail. The guide carriages are all-steel throughout, and embody the latest improvements in lubrication. The weight of the holder is 780 tons, and the whole of the riveting on the site has been carried out by hand.

Mines Safety Research.—The British Government recently made proposals to the French Government for a scheme of co-operation between the official organizations in the two countries which are engaged in research work directed towards securing greater safety in coal mining. These proposals have been cordially accepted; and the scheme is now to be put in operation. On the British side the technical arrangements will be in the hands of the Safety in Mines Research Board. They will include a full interchange of information acquired by accident-prevention research and experience in the two countries, including unpublished as well as published reports. The respective research organizations will mutually agree which problems each could best study alone, and which could more effectively be studied jointly. By this means it should be possible to save money and expedite the work.

JOINT COUNCIL OF THE JUNIOR GAS ASSOCIATIONS.

Minutes of a Meeting in Bristol on Nov. 17.

A Meeting of the Junior Gas Associations' Joint Council was held in Bristol on Nov. 17, under the chairmanship of Mr. C. B. FELTON. The delegates present were Messrs. W. J. Pickering (Education Representative), W. T. Kenshole, F. S. Larkin, Arthur Tennant (London and Southern District Association), H. J. Hailstone, H. C. Applebee, J. Alsop (Manchester and District Association), John Murray, Ronald Keillor, Alex. Bujnowski (Scottish Western Association), F. C. Caudwell, A. R. Myhill, H. W. Wills (Midland Association), R. W. Webb, H. E. Wilde (Yorkshire Association), C. B. Felton, W. E. Crawley, H. S. Bartlett (Wales and Monmouthshire Association), T. B. Armitage, A. Marsden, G. C. Gunston (Western Association), and H. B. Knowles (Hon. Secretary and Treasurer).

The PRESIDENT (Mr. T. B. Armitage), who at the outset occupied the chair, opened the proceedings by saying that the Wales and Monmouthshire and the Western Associations were acting as joint hosts to the Joint Council that day. Though smaller numerically than the other Associations, their members were none the less keen. His position as President of the Western Association, and Past-President of the Wales and Monmouthshire Association, was unique, inasmuch as, through bearing office in these two Associations, it had been his privilege to apply for affiliation to the Joint Council on behalf of the latter Association in 1922, and for the former in 1926. He gave a hearty welcome to the delegates, and trusted they would have a most enjoyable and profitable visit to Bristol. At this point in the proceedings he asked Mr. Felton, of the Wales and Monmouthshire Association, to take the chair.

The minutes of the meeting held on Oct. 13, 1927, at Birmingham, were taken as read.

The HON. SECRETARY read letters of congratulations to Mr. H. D. Madden, and the replies thereto.

The CHAIRMAN then called upon Mr. Alsop to read the Joint Council rules, which he had been delegated to revise and bring up-to-date.

It was decided that each rule should be discussed immediately after being read out.

A great deal of controversy centred around these rules; and finally it was decided, on the motion of Mr. TENNANT (seconded by Mr. ARMITAGE), that copies of the rules be forwarded to each Association, to be amended (or any additions made thereto), and afterwards returned to the Hon. Secretary to be finally brought up for ratification at the next Joint Council meeting.

The HON. SECRETARY then read his report, and submitted the balance-sheet of the year's working.

On the motion of Mr. ARMITAGE, seconded by Mr. KENSHOLE, the report and balance-sheet were adopted.

The "Transactions" account for Volume 17 was also adopted.

Mr. ARMITAGE, seconded by Mr. BARTLETT and supported by Mr. KENSHOLE, moved that Mr. Knowles be again asked to take on the duties of Hon. Secretary and Treasurer for the year 1929-30.

A hearty vote of thanks was proposed by Mr. TENNANT, seconded by Mr. MARSDEN, and supported by Mr. KENSHOLE, to the Secretary for the services he had rendered during the past year.

Mr. KNOWLES informed the meeting that he would have to consider whether to continue in office; and it was agreed that the Western Junior Association (whose turn it was to appoint the new Secretary) should be notified of his decision as early as possible.

The CHAIRMAN then called upon Mr. Pickering to give the Education Representatives' Report.

In his opening remarks Mr. PICKERING said he regretted Mr. Bridge's absence, but would state that they were both in agreement with everything that was going to be read.

REPORT OF EDUCATIONAL REPRESENTATIVES.

Since our last report on Oct. 13, 1927, the most notable feature in connection with the Education Scheme has been the work of the District Committees, which twelve months ago were just getting into their stride.

That the entries for the various examinations this year have not shown a greater advance on those for previous years is no reflection on the work of the District Committees, for it is agreed by all who are competent to express opinion on the matter that these Committees have carried out their duties in a manner which has exceeded expectations.

The difficulties associated with the working of the Scheme are due to faults in several quarters, and do not rest entirely with either the students, the undertakings, or the regulations; and, in our opinion, the most important outcome of the work of the District Committees has been that, through them, the General Committee has been brought to realize in clearer manner the very real difficulties which are still associated with the working of the Scheme.

The latter question received full discussion at a special meeting of the Institution members of the Gas Education Committee and the representatives of the District Committees, held on Oct. 9, when a letter from Mr. F. C. Briggs, of Dudley, to the Council of the Institution, was considered. Some frank expressions of opinion were made at this meeting, and an important development was the decision to send out a questionnaire to all the District Committees, asking for information as to the points of difficulty in connection with the working of the Scheme.

It is likely that a list of qualifying examinations in ancillary subjects will be prepared very shortly in conjunction with a modified and simpler list of regulations. This step should materially assist the difficult case of many external students, and quickly lead to a substantial increase in the entrants for examinations.

A feeling of optimism may perhaps be more legitimately indulged in at the present time than on any previous occasion in the history of the Scheme, as all those concerned with its administration are determined to put forth every effort to make it of still greater value to the industry. We feel that the increase in number, through the personnel of the District Committees, of those who now have some working knowledge of the Scheme will ensure that the right lines of development are more quickly followed.

Mr. Pickering went on to say that thirteen months ago the Education Sub-Committee was formed, to meet once a month. He was elected on that Committee, had attended every meeting, and could say that a good deal of work had been done. At this stage he desired to pay tribute to the work of Mr. Creasey and Mr. Tagg (Chairman of the Lancashire District Committee).

Mr. ARMITAGE moved the adoption of the report, and Mr. HAILSTONE seconded, remarking that they were deeply indebted to Mr. Bridge for his work in connection with the Education Scheme.

The HON. SECRETARY then read out a letter from Mr. Bridge resigning the office as one of the Education Representatives.

Mr. PICKERING here suggested that it was unnecessary to elect another representative in Mr. Bridge's place, as the interests of the Joint Council were adequately safeguarded by the manner in which the Education Scheme was being worked.

On seconding this motion, and after apologizing for the absence of Mr. C. H. Chester, Mr. WEBB said he regretted the loss of Mr. Bridge's services. He moved that Mr. Pickering be accorded the best thanks of the Joint Council for his valuable work, and that he again be elected as the Education Representative. This latter resolution was ably supported by Mr. ALSOP, and carried unanimously.

In reply, Mr. PICKERING thanked the Joint Council for appointing him their representative for another session, and assured them he would again do his utmost in their interest.

Mr. HAILSTONE moved, and Mr. WEBB seconded, that a letter be written to Mr. Bridge by the Secretary, regretting his resignation and according him the best thanks of the Joint Council for his valuable work in the past.

A letter received from the Midland Junior Gas Association on the limitation of papers in Transactions was withdrawn on hearing that the cost of the same had been reduced.

Mr. JOHN MURRAY, on behalf of the Scottish Junior Association (Western District), extended a cordial invitation to the Joint Council to hold the next meeting in Glasgow. The offer was unanimously accepted.

A hearty vote of thanks, by Mr. WEBB, was accorded to the Western Junior and the Wales and Monmouthshire Associations, coupling with it the Directors of the Bristol Gas Company, for the hospitality and kindness extended to them that day, and to the Chairman for the able manner in which he had conducted the meeting.

The CHAIRMAN replied, and was ably supported by Mr. ARMITAGE on behalf of the Western Association.

American Natural Gas Production.—The history of the natural gas industry in 1927 was similar to that of the petroleum industry, as a record output was marketed at reduced prices, says the United States Bureau of Mines. The total amount of natural gas produced and delivered to consumers in the United States in 1927 amounted to the huge total of 1,445,428 million c.ft.—an increase over 1926 of 132,409 million c.ft., or 10 p.ct. During the year, 184 million c.ft. of gas were piped to Canada and Mexico, which, when deducted from the total production, leaves 1,445,244 million c.ft. as the total amount of natural gas consumed within the United States in 1927. The value of the gas per 1000 c.ft. at the wells decreased from 9·5 cents in 1926 to 8·8 cents in 1927, and at points of consumption from 22·9 cents in 1926 to 22·0 cents in 1927.

MANCHESTER AND DISTRICT JUNIOR GAS ASSOCIATION.

Visit to the Preston Gas-Works.

On Dec. 1, members of the Association assembled at the Walker Street Works of the Preston Gas Company, and were received by the Assistant Engineer, Mr. W. L. Heald.

Mr. HEALD, welcoming the visitors, said that the Preston Gas-Works were established about the year 1813, and up to the present time they had only had four gas engineers in 115 years. The purifiers there were the first in the country to be built having rubber joints and balcony plates. One of the interesting features of the works was that all the workshops were under one roof, and included joiners', wheelwrights', blacksmiths', fitters', cooker cleaners', tinsmiths', meter repairers', and plumbers' shops.

There followed an inspection of the new works, which are in course of erection. The retort house buildings and benches, and also a 3-million spiral-guided holder, are built; a 36-in. main 2½ miles in length has been laid; the purifiers are being constructed.

Afterwards, tea was served in the Public Hall in the town. Mr. S. Tagg, Engineer and Manager to the Preston Gas Company, presided, and was supported by the President of the Association, Mr. H. J. Hailstone, and Dr. M. W. Travers, F.R.S. (Bristol), one of the inventors of the "Regenerative" complete gasification plant.

Mr. TAGG welcomed the party on behalf of the Directors of the Gas Company, and expressed regret that the new works were not sufficiently advanced to be of great technical interest.

Mr. J. CARR (Stretford) moved, and Mr. S. L. WRIGHT (Colne) seconded, a vote of thanks to the Gas Company for their kindness and hospitality; and Mr. TAGG and Mr. HEALD replied.

THE WORKING AND DEVELOPMENT OF THE REGENERATIVE COMPLETE GASIFICATION SYSTEM.

By A. K. COLLINGE, of the Preston Gas Company.

The "Regenerative" coal gasification system was introduced by Dr. M. W. Travers, F.R.S., and F. W. Clark, M.I.Mech.E., in 1922. The first plant working under this system was constructed at Aylesbury, and commenced gas-making in February, 1923; the rated capacity being 300,000 c.ft. per 24 hours. The experience gained with this plant, and the results obtained, led to the erection in 1925 of two more plants—one at Preston rated at 500,000 c.ft., and one at Harrow rated at 1 million c.ft. per 24 hours. Both these plants were of greatly improved design, and further large-scale experiments have been carried out on the Preston plant, which the writer proposes to describe.

DESCRIPTION OF THE SYSTEM.

The system of complete gasification, by which the coal is completely gasified in one vessel, is similar to other systems in that the gas producer consists of a carbonizing chamber superimposed upon a water gas generator; but here the analogy ceases. Only about one-third to one-half of the total heat required to carbonize the coal can be obtained from the water gas, and the deficiency is made up by recovering the heat of the waste gases during the blow period in a separate regenerator, and transferring it direct to the coal during the "run" by circulating a stream of gas through the regenerator and thence through the coal in the carbonizing chamber. The sensible and latent heat of the blow gas is thus used to carbonize the coal by internal heating; and in actual practice there is always far more heat available than is required.

A plan of the general arrangement of the plant is shown in fig. 1, and a part section of the original generator, regenerator, and carburettor in fig. 2. It will be seen that the plant is exceedingly compact; the ground space being only 2 sq. ft. per 1000 c.ft. of gas per day, while there is ample room for all the necessary working and cleaning operations. The blast main is connected to the main supplying two water gas plants; the blast being raised by turbine driven fans.

The three vessels A, B, and C are constructed of steel shells well insulated and lined with firebrick. The regenerator and carburettor are filled with chequer brickwork. The lower section of the generator is similar to a water gas generator, being provided with air and steam inlets and an outlet for the down-run gas. The carbonization section of the producer is 14 ft. in height, and as first erected (fig. 2) tapered from 3 ft. 6 in. diameter at the top to 6 ft. diameter at the bottom. At this point, where the carbonization of the coal has been completed, is an annular channel or trench (M) open to the generator through a number of vertical slots or nostrils, and communicating with the bottom of the regenerator. The blow gases pass through this channel after passing through the coke, being prevented from rising through the coal in the carbonization section. Part of the blow gases escapes through the regenerator stack, and the remainder passes down through the carburettor and away through the carburettor stack; the relative proportions being controlled by slides immediately beneath each stack. During the run, the circulation gas is drawn from the outlet of the last scrubber G by means of a Sturtevant circulating machine, and forced down through the regenerator and trench into the generator. Here it mixes with the water gas passing upwards from the lower section of the generator. The mixed gases then pass up through the coal and through the gas outlet pipe to the washer, scrubbers, and condensers. A proportion of the circulation gas is allowed to pass through the carburettor if oil is being used, and through the washer and scrubber K to the outlet of the plant. Thus no carburetted gas can be circulated and over-cracked.

The coal is elevated to an overhead storage bunker from a push-plate conveyor which supplies a bench of horizontal retorts; a belt conveyor being used for this purpose. A gas-tight hopper O is filled from the bunker, and a known weight of coal is charged into the generator every three runs by means of the quadrant valve and bell.

THE OPERATING CYCLE.

Supposing that the plant is in operation, a complete "cycle" is carried out as follows: The blast valve is opened, and air passes through the coke in the generator *via* the nostrils and trench, through the regenerator and carburettor, and escapes through the two stack valves. Secondary air can be admitted at four points as is found necessary.

The blow occupies two minutes, after which the air valves are closed, and the valve admitting steam to the bottom of the generator is opened. The stack valves are then closed, and the circulation is started by means of a hand-wheel, which operates three separate gas valves and a steam valve on the circulator engine. The oil supply to the carburettor is turned on, being measured by a patent meter fitted with an automatic knock-off device, and the run continued for six minutes. The rate of circulation can be controlled by an auxiliary steam valve on the circulator engine. The volume of gas which passes through the carburettor is regulated by means of the butterfly valve N controlled by an "Arca" regulator.

The outlet of the carburetted gas scrubber is shown in detail in fig. 4. The valve *a* opens as the circulation is started. In the outlet pipe at *b* is an adjustable orifice, from opposite sides of which pipes *c* and c^1 lead to the gauge board and also to the diaphragm chamber of the "Arca" regulator. The impulse of the regulator is conveyed to the butterfly valve N by a wire and balance weight, so that there is a constant drop in pressure at the orifice *b* and, therefore, a constant flow of gas through the carburettor. This rate was maintained constant independently of the pressure within the plant. The system worked perfectly with practically no attention; but after some time the conditions of operating the plant and the pressures within it were so steady that the automatic regulator became unnecessary and was made use of elsewhere—the valve N being altered at rare intervals by a hand wire.

At the end of the run, the circulation and steam are stopped, and for a few seconds steam is passed into the plant at points immediately beneath both stacks by means of a scavenging valve. This drives the gas out of the regenerator and carburettor, after which the stacks are opened and the blow commenced.

Every third run is a down-run, during which the steam enters beneath the carburettor stack-valve, passes through the carburettor and regenerator, whereby it becomes superheated, and down through the fuel bed. It will be seen that during a down-run it is not possible to circulate gas or to admit oil.

During the blow periods, distillation gas, mixed with steam and tar vapour, continues to be given off from the coal in the upper section of the gas generator. This is drawn off through the washer and condenser by means of the slow-running circulator, and the permanent gas is delivered to the relief holder, the volume being controlled by a 3-in. slide valve. The analysis of a sample of distillation gas is given in Appendix I. The high percentage of inerts in this instance is due to blow gases being drawn up through the coal.

In order to obtain the highest possible efficiency from the plant, every operation is under accurate control. The blast is measured in volume of air per minute by means of a venturi meter, and the steam for both up and down runs is measured in pounds per minute by means of orifice meters. This type of meter is also used to measure the volume of gas being circulated during the run, the volume of gas passing through the carburettor, and the volume of "distillation gas" being drawn off by the slow-running circulator during the blow. There are five thermo-couples fitted in the plant; the temperatures being indicated by two milli-voltmeters supplied by the Cambridge Instrument Company. These instruments are assembled on a gauge-board, together with various pressure gauges and a clock, immediately behind the row of operating levers (fig. 5). The latter are all interlocked, so that it is impossible for the

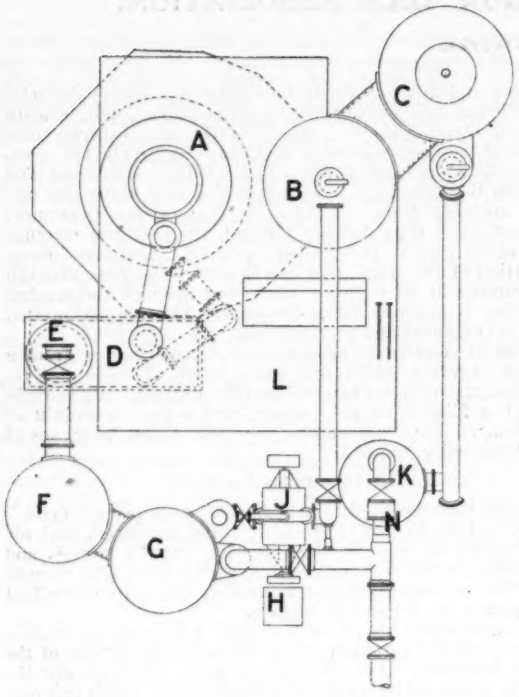


Fig. 1.

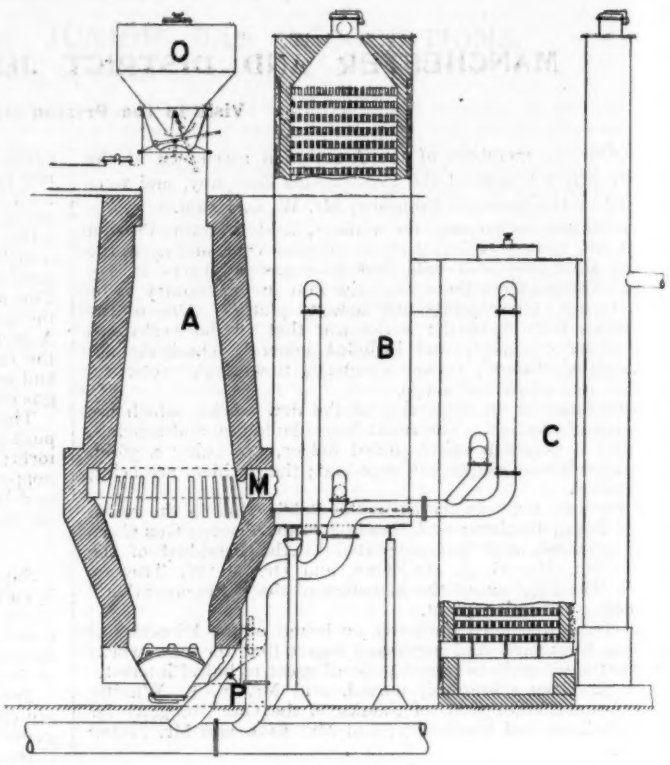
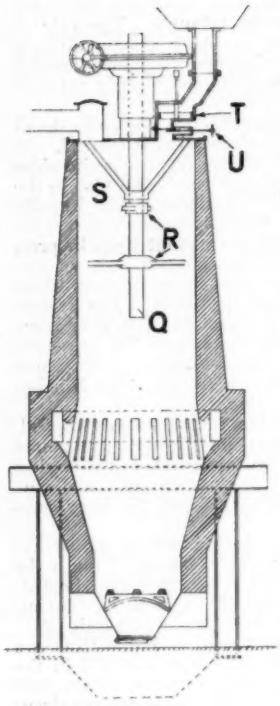


Fig. 2.



A Generator.
B Regenerator.
C Carburettor.
D Washer.
E Scrubber.
F Water-cooled condenser.
G Scrubber.
H Steam engine.
J Circulating machine.
K Scrubber for carburetted gas.
L Operating floor.
M Trench.
N Valve controlling volume of carburetted gas (see fig. 4).
O Gas-tight coal hopper.
P Primary air venturi meter.
Q Hollow shaft.
R Stirring arms.
S Stays.
T Automatic coal feeder.
U Coal valve.

Fig. 3.

operator to make any mistake. Alongside the gauge-board are a number of nozzles, each of which is connected to a blast or secondary-air valve, and which indicates and releases any leakage of gas through the valves. All the instruments are marked at points determined by experience, so that the operator's work soon becomes almost mechanical.

The whole of the work of running the plant is undertaken by one man without assistance. Clinkering is carried out every twelve hours by two men and the operator in about twenty minutes.

WORKING OF THE PLANT.

The plant was put into operation in November, 1925. No trouble was experienced with regard to the complete carbonization of the coal before it reached the trench level; and from subsequent experiments and observations, it has become evident that the coal was being carbonized for a longer period than was necessary. The coal used consisted mainly of unscreened Wigan Arley, and, since it had passed through the breaker, it contained a considerable proportion of fine coal and dust. This was the cause on several occasions of the fuel holding-up in the generator; and the trouble was overcome by placing a small bar screen at the feed to the belt conveyor, the fine coal being used on the horizontals. This does not remove all the dust by any means, but it has been found sufficient for its purpose. The small coal and dust also caused trouble by being blown over into the washer by the gas being circulated. This necessitated the washer being cleaned out every week; each time occupying about three hours. By working with a lower fuel level in the generator and inserting a small plate in the gas outlet pipe, this difficulty was completely overcome; the average run of the washer being increased to three months. The washer through which the carburetted gas passes is only cleaned out when the plant is closed down.

A difficulty which presented itself rather forcibly to our notice after several weeks running was the deposition of hard carbon on the brickwork in the regenerator top from the tar fog remaining in the circulation gas. The latter was being forced into the regenerator at a temperature of about 140° Fahr., and it was necessary to " blow carbon " twice each day, for half-an-hour each time, in order to burn-off this deposit. This carbon deposit has been minimized by effecting a considerable reduction in the volume of gas circulated, and by increasing the water supply to the condenser. We also installed a trap to remove the tar fog on the inlet of the circulator. This con-

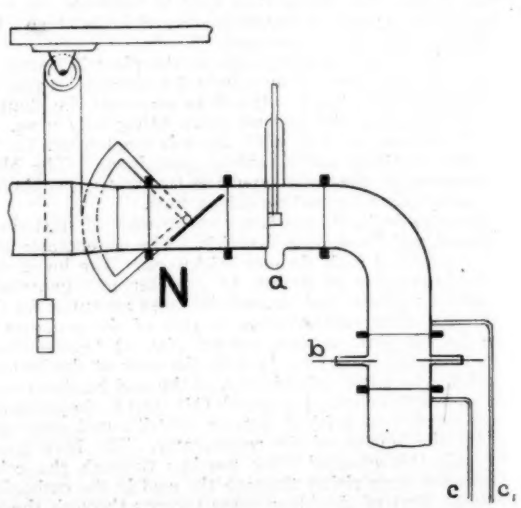


Fig. 4.

sisted simply of a welded steel box with a perforated plate and baffle, the tar being thrown down by friction; and it has been found to be very successful. The time occupied by carbon blowing, which caused a serious loss in the daily output of the plant, was by these means reduced to ten minutes each day.

A further serious loss of potential gas-making time lay in the filling of the gas-tight coal hopper from the overhead bunker. This is filled five times per 24 hours on an average; the total time being 1 to 1¼ hours. This loss can only be overcome by structural alterations, and methods have been devised by which the hopper can be filled without extra labour while the plant is making gas.

The outlet main from the plant is connected to the main from two water gas plants, so that it is only possible to measure the gas made when the water gas plants are not in operation. In the following table the results of a complete month's continuous working are given. The gas from the relief holder is measured in a wet station meter, and the volumes are corrected to 60° Fahr. and 30 in. barometric pressure. The weight of coal used is obtained from the number of hoppers charged into the generator; the average weight of a hopper being previously determined by a number of actual experiments. It was assumed that the hopper was completely filled every time.

Actual Results for the Month of March, 1926.

Total number of runs made	4,282
Average runs per day	138
Average daily running time	18 hrs. 24 mins.
Coal used	268 tons.
Coal used per day	8 tons 13 cwt.
Gas made	12,743,200 c.ft.
Gas made per ton	47,550 c.ft.
Calorific value	440 B.Th.U. gross.
Therms	209·2
Oil used	11,273 galls.
Oil per ton of coal	42 galls.
Therms per ton of coal from oil (0·9 therm per gallon)	37·8
Therms per ton of coal available as town gas	209·2 − 37·8 = 171·4

During this month the oil used was equal to 0·88 gallon per 1000 c.ft. The uncarburetted gas can be tested separately, and

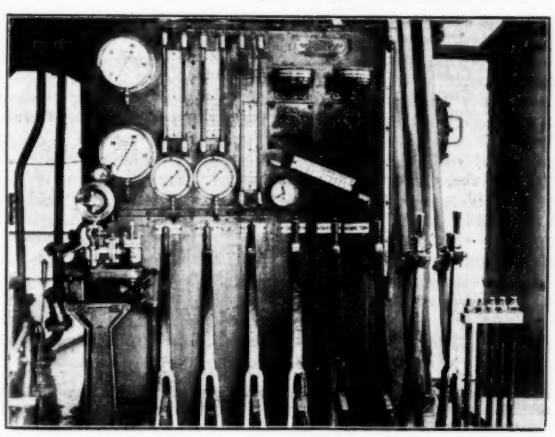


Fig. 5.—Operating Levers and Gauge Board.

averaged 360 B.Th.U. per c.ft., while the average for the gas from the relief holder was 440 B.Th.U. Thus the efficiency of carburetting over that period was 0·9 therm per gallon.

The result is given on the wet basis, and no account is taken of coke removed from the generator during clinkering operations. The plant used the same coal as was supplied to the horizontal retort bench, which consisted of a mixture of Wharncliffe Woodmoor, Wigan Arley, Barrow, and Barnsley Main; all being unscreened. The percentage of ash in these coals varied from 2 p.ct. to 16 p.ct., and the moisture averaged 2 p.ct. The working conditions made it impossible to supply only the best coal to the plant.

Efficiency and Output.

From these figures it will be seen that the system was fully justifying the claims made by its inventors so far as efficiency went. The daily output, however, was only about 411,000 c.ft.; and this was largely due to the time loss to which reference has been made. The make has been increased to 480,000 c.ft. by the saving in time brought about as described, so that, by eliminating the time lost in filling the coal hopper, the specified half-million would be easily reached.

After eight months' continuous running, the plant was converted, by a slight alteration, to a suction gas plant, owing to the coal strike of 1926. For five months the plant produced 150,000 c.ft. of low-grade gas per day, working on coke alone and with practically no labour. In December, 1926, the normal working with coal was again restored without the plant having been let down, and this was continued for a further two months with the so-called coal which was delivered at the latter end of the strike. We had our difficulties, but we managed to continue making gas until the plant was let down for alterations after being in continuous operation for over fifteen months. No mechanical repairs were found to be required; the only repairs being the re-lining of the generator for 4 ft. above the firebars, and the renewal of one course of chequers in the carburettor and nine courses in the regenerator. The latter was heavy owing to the deposition and burning-off of the carbon during the earlier stages of the plant's working; but after a further run of eight months, it was found unnecessary to renew a single brick.

Alterations to the Generator.

As a result of a number of facts which had been brought to light, it was resolved to carry out certain alterations to the generator. First it was found that a greater volume of gas had to be circulated than was calculated in theory. This was thought to be caused by the gas forcing channels through the plastic coal, thus causing uneven carbonization; and this theory was borne out by a study of the pressures within the plant. Secondly, in the Harrow plant, which was designed for double the output, it was found impossible with the larger generator to carbonize sufficient coal to produce the required volume of gas. It was also realized that it was impossible to deal with coals with a high percentage of small and fine coal in the existing type of generator. The problem was carefully studied from all its aspects by Dr. Travers and Mr. Clark; and after considering several schemes, they decided to instal an apparatus for slowly stirring the coal in the upper part of the generator, to bring about even carbonization and thus increase the throughput. There was a large variety of mechanisms in use for agitating the fuel in gas producers; but the problem was much more difficult of solution with the complete gasification plant owing to the higher pressures which obtained, and to the complete lack of knowledge as to the depth at which the fuel should be stirred to obtain the best results. Since this was a purely experimental scheme, it was proposed to make a trial on the Preston plant as being less costly; and with the consent of Mr. Tagg this was carried out in the summer of 1927.

A cross section through the altered generator and the stirring apparatus is shown in fig. 3. No alteration was made to the shell of the generator. The coal feed was removed, and the brickwork taken out as far down as the trench. This was left untouched, the blocks being in good condition. When the lower part of the generator was relined, the set-off shown in fig. 2 was not replaced, as it was inclined to collect clinker, and a small increase in the grate area was thus obtained. The upper part of the generator was then rebuilt without any taper; the full diameter of 6 ft. being maintained to the top. The stirring apparatus consists of a vertical hollow shaft, Q, which is water cooled and extends 9 ft. down the centre of the generator. Provision was made on it for three arms; but owing to the uncertainty of the results, only two were fitted. These are 3 ft. and 6 ft. below the generator top, extend to within 6 in. of the sides, and are driven round at the slow rate of one complete revolution in 10 minutes. They were made, by Messrs. Hadfields, Ltd., of high-temperature resisting steel guaranteed to withstand a stress of 2 tons per sq. in. at 800° C. The shaft is held by a collar and four stays S, which was water cooled, and is driven by a 3-H.P. electric motor by means of a chain and worm gearing. The latter was made of very heavy construction, since there was no existing data of the strains which were likely to be met.

The coal hopper O was removed to one side to clear the stirring mechanism, and an automatic coal feeder T installed. This consisted of a drum divided into five sections by radial fins, which slowly revolved horizontally inside a cast-iron cylinder. The feeder was connected to the coal hopper by a welded steel pipe, and a slide valve U was installed beneath it as shown. The coal feeder was also driven by the 3-H.P. motor by means of an adjustable arm, so that the rate of feed could be easily varied. Later we constructed an automatic knock-off device, which stopped the motor immediately any obstruction entered the feeder. The whole of the generator top was cooled by the water which had passed through the centre shaft. It was necessary to alter the gas outlet pipe as shown, so that the gas now leaves the top of the generator in a vertical direction instead of horizontally.

Operation of Agitating Arms.

The plant was started up at the end of October, 1927, the usual procedure of running on coke until working heats are obtained being followed. It is customary to make blue water gas for a period, since we are in a position to use extra oil on the water gas plant. By this means we are gas-making within 1½ hours of lighting the fire, no water gas is burnt to gain heats, and within 12 to 15 hours coal can be charged into the generator. The time is, of course, very much less if the water gas is burnt instead of being sent to the relief holder. The level of the coal in the generator can be determined by means of two feelers fitted in the top, or by making use of a poke-hole; and the coal level was maintained at 2 ft. 5 in. below the top. Thus the top stirring arm was 7 in. in the coal, and the bottom arm 3 ft. 7 in. The arms were not started until

coal had been charged into the generator and temperatures throughout the plant were normal.

Twelve hours after starting the agitating arms, difficulty was experienced in passing through the fuel bed the required volume of primary air. The length of the blow was increased proportionately; but as time went on the resistance offered by the fuel bed became so great that it was almost impossible to pass through any primary air at all. The clinkering doors were opened, and it was found that the generator was full of red-hot powdered coke of such a degree of fineness that it ran out of the doors like a molten stream. It was obvious that the slow movement of the arms was powdering the coke; and it was decided to work with a lower fuel level in the generator, so that the lower arm would not be rotating in the coke. The design of the drive made it impossible to run the arms intermittently for short periods and to keep the generator supplied with the required quantity of coal.

The whole of the powdered coke was removed from the generator, and a fresh start was made with coke. In a few hours coal was again charged to the generator, and the fuel level was maintained at 5 ft. below the top, so that the top stirring arm was rotating above the coal, and the bottom arm had a depth of 1 ft. of fuel above it. Powdered coke was again noticed when the plant was clinkered, with the accompanying difficulty caused by a high fuel bed resistance. Since it was impossible for the coal to be carbonized in a travel of 1 ft. down the generator, it was thought that the dust was formed as a result of the passage of the arm through coal which was in a plastic or semi-carbonized state. The average temperature of the gases leaving the top of the generator was 400° C., at which coal is in a state of "fusion." We attempted to run the plant below this temperature, at 300° to 350° C.; but this was almost impossible, owing to the excessive back-pressure produced as a result of slower carbonization, and the consequent increase in the depth of plastic coal through which the circulation gas had to be forced.

The trouble with powdered coke was not so acute as to necessitate emptying the generator again, and we continued running, and dropped the fuel level a further 6 in., leaving 6 in. of coal above the arm. The following day dust again appeared in considerable quantities when the plant was clinkered, and the usual high fuel bed resistance was experienced. The coal was travelling down the generator during this period at about 8 in. per hour, so that it was evident that it reached the temperature of the outlet gases within three-quarters of an hour, and that the coal should not be stirred when it has become partly carbonized, however slowly. The fuel level was again dropped a further 6 in., so that the bottom arm merely acted as a leveller and agitated the surface of the coal only. No further trouble with dust occurred; and none has appeared since.

It should be noted that the combined effect of widening the carbonizing chamber and working with a lower fuel level caused a reduction of 10 p.ct. in the available retort volume, and consequently the carbonizing time.

IMPROVEMENTS DUE TO ALTERATIONS.

The direct improvements in working brought about by the installation of the stirrer and the alterations to the generator can be summed up as follows: The volume of gas circulated during the run was reduced by about one-third (from 2600 to 1750 c.ft. per minute), and the average temperature of the gases leaving the generator was reduced from 600° to 400° C. Consequently the gas could be more efficiently washed and cooled, and the deposition of tar in the upper part of the regenerator was entirely eliminated. The conclusion arrived at was that with a coal containing a considerable amount of small material and dust, there is an advantage to be gained by levelling the fuel bed and agitating the surface; but if a moderately large coal is used, free from smalls and dust, it is doubtful whether the advantage gained is worth the extra cost of plant and upkeep.

Our experiences with the automatic coal feeder have not been very happy. The principle of a regular feed was very desirable, but no provision was made for the removal of any obstructions, and trouble was caused by pick-heads, &c., getting in with the coal. After nine weeks' running the drum became seized, and since it could not be moved either way the whole feeder was removed. The cause was found to be about twenty yards of covered copper wire wound round the drum, and the feeder was replaced by a sloping steel pipe connecting the coal valve with the overhead hopper. Coal was charged to the generator intermittently by opening the valve for a few seconds; and though this method leaves much to be desired, we have found it fairly satisfactory.

PRACTICAL ADVANTAGES OF COMPLETE GASIFICATION PLANT.

The chief practical advantages of a complete gasification plant over a separate retort and water gas plant are as follows: The capital outlay is about three-fifths; the relative ground space is considerably less; the labour employed is in the neighbourhood of one-third; and less than half as much solid material has to be handled. The method of carbonizing the coal by the circulation system is an economical success. It has been proved that one-third of the heat value of the blow gas is utilized in the plant, the equivalent of which is 1 cwt. of coke per ton of coal carbonized. The coke necessary to raise steam for the circulator engine is considerably less than 1 cwt. of coke per ton of coal, so that the equivalent coke required to carbonize the coal is under 2 cwt. per ton. An average figure for vertical retorts can be taken as 3 cwt.

In conclusion, I would like to point out the great advantage of the complete gasification plant over the ordinary type of water gas plant using coke. This is that coal yields 30 to 50 more therms per ton when completely gasified than does coke, which means a direct saving of 0·5 to 0·7 gallons of oil per 1000 c.ft. of gas made; and the greater the price of coke over coal, the greater this advantage. Both plants are equally flexible; and with the new design embodying only one stack valve, a waste-heat boiler can easily be added.

I wish to thank my Chief, Mr. Samuel Tagg, M.Inst.C.E., J.P., Engineer and Manager of the Preston Gas Company, for his permission to publish the figures and details given in this paper, and for his helpful interest in the work involved. My thanks and appreciation are also due to Dr. M. W. Travers, F.R.S., and the late Mr. F. W. Clark, M.I.Mech.E., whose pioneer work has proved so successful.

APPENDIX I.

Sample.	CO_2.	CmHn.	CO.	CH_4.	H_2.	N_2.	Calorific Value.
Distillation gas .	6·4	1·0	14·1	18·0	39·1	20·9	374·8 B.Th.U.
Uncarburetted gas	4·6	0·6	32·6	7·9	47·8	6·5	362·4 B.Th.U.
Carburetted gas .	3·1	5·1	32·1	14·4	39·7	5·6	507·5 B.Th.U.

APPENDIX II.

Comparative costs of materials for producing 450 B.Th.U. gas by—

(*a*) Carburetted water gas plant.
(*b*) Complete gasification plant.

The following figures are assumed:

1 ton of coke produces 50,000 c.ft. of 285 B.Th.U. gas = 142 therms.
1 ton of coal produces 47,550 c.ft. of 360 B.Th.U. gas = 171 therms.

	s.	d.
Coke	25	0 per ton.
Coal	25	0 per ton.
Oil	0	5 per gallon, producing 0·9 therm.

	Cost. s.	d.		Cost per Therm d.
(*a*) Coke, 50,000 × 285 = 142 therms . .	25	0	..	2·11
Oil, 91 galls. = 82 therms . .	37	11	..	5·55
224	62	11	..	3·37
(*b*) Coal, 47,550 × 360 = 171 therms . .	25	0	..	1·75
Oil, 47·5 galls. = 43 therms . .	19	9	..	5·55
214	44	9	..	2·51

The cost of coke to raise steam for circulating the gas, on the complete gasification plant, is 0·09d. per therm, so that the relative costs per therm for materials are—

3·37d. for the carburetted water gas plant,
and 2·60d. for the complete gasification plant.

The saving in cost is thus 0·77d. per therm, or 3·46d. per 1000 c.ft.

Discussion.

Dr. TRAVERS paid a high tribute to his late partner, Mr. F. W. Clark, who had a large share in the production of the "Regenerative" plant. He also referred to the interest shown in the plant by Mr. Tagg. Dr. Travers then gave some interesting details of the stages by which the inventors had overcome the various difficulties in the development of the plant. To his mind, complete gasification was a sound proposition.

Mr. HAILSTONE (Rochdale) asked if Mr. Collinge could give him the figures for moisture content and ash content in the coal.

Mr. COLLINGE replied that they were 2 p.ct. and 6 p.ct. respectively.

Mr. CARTER (Liverpool) said that at Liverpool they had solved the coke question by their C.W.G. plant.

Mr. WRIGHT (Colne) mentioned the trouble they had with tar emulsion, and asked if they had tried the raising of the stirrer arm.

Mr. COLLINGE observed that they had not had trouble with their tar emulsion; and the percentage of pitch was very low. The arm had not as yet been raised, but they would possibly be experimenting later.

Mr. J. T. HAYNES (Bolton) complimented the author upon his paper, and asked if the plant was capable of dealing with any class of coal. What was the amount of NH_3? He thought the generator could be designed so that even better results could be obtained.

Mr. COLLINGE replied that the plant would be successful with a non-caking coal. There was about 40 grains of NH_3 per 100 c.ft. of gas.

Mr. BYRT (Burnley) moved, and Mr. LUPTON (Liverpool) seconded, a vote of thanks to the author for his paper, to which Mr. COLLINGE replied.

LONDON AND SOUTHERN DISTRICT JUNIOR GAS ASSOCIATION.

Discussion on Refractory Materials.

A Meeting of the London and Southern District Junior Gas Association was held on Nov. 30 at the Westminster Technical Institute, Vincent Square, S.W., under the presidency of Mr. W. TREVOR KENSHOLE, of the Lea Bridge Gas Company. The subject under discussion was that of refractory materials; the lecturer being Mr. A. T. Green, of the Derbyshire Silica Firebrick Company, Ltd., of Friden, who based his remarks on his contribution, "A Consideration of the Properties of Silica and Fireclay Products in Relation to the Carbonizing Industries," to the Carbonization Conference of the Joint Fuel Committee which took place in February last. That contribution, and the discussion to which it gave rise, were published in the Carbonization Number of the "GAS JOURNAL;" and what follows is a summary of Mr. Green's remarks on Nov. 30.

REFRACTORY MATERIALS IN RELATION TO THEIR USES IN VERTICAL RETORTS.

By A. T. GREEN, F.Inst.P., A.M.I.Chem.E.

INTRODUCTION.

The carbonizing industries, mainly by reason of their wide range of technical activities, have always been to the front in industrial research. Investigations concerning the efficiencies of carbonizing installations have received adequate attention, and have certainly led to well-placed improvements in the design and operation of such plants. The trend of design is naturally towards the attainment of maximum efficiency and flexibility. These two desiderata are often opposed, and a compromise is all that can be expected. Nevertheless, the application of such progressive methods has led to the adoption of higher temperatures of carbonization, with the result that conspicuous attention has been focussed on the properties of refractory materials.

With the increasing duties of modern working, materials which were considered capable of satisfying the demands of the older practice are said to be unable to stand up to the new conditions with economic success. Furthermore, peculiarities concerning the durability of retorts, which were hardly realized a decade or so ago, are now being generally encountered. Many of these are causing great trouble; and their elucidation is a matter of urgent moment, for the vitality of the gas industry lies in the retort house.

Generally speaking, the factor of safety in the industrial usage of refractories is, of necessity, comparatively low. In fact, there often appears to be little difference between those conditions of usage which assure success and those which result in premature failure. A frank recognition of this state of affairs by all concerned would be a great help in advancing the technique of refractory materials, and, consequently, in improving the behaviour of these products in industry. In fact, this attitude of mind appears to be fundamental to the consummation of successful research into the utilization of refractory materials in the carbonizing industries.

THE ESSENTIAL DIFFERENCE BETWEEN FIRECLAY AND SILICA PRODUCTS.

In the carbonizing industries there is a marked trend towards the usage of silica products for the retort proper and the combustion chambers. In fact, this practice is rendered necessary where the higher temperatures of carbonization are the rule. This necessity is made apparent by a study of the data derived from testing the behaviour of the two types of product under loads at high temperatures. Such information can be obtained from the recognized refractoriness-under-load test.

A silica product is essentially a crystalline aggregate bonded with a glass-like constituent. Most of the quartz, which is the basic substance of the raw rock, has been transformed, by the influences of high-temperature firing and a lime-bearing matrix, into cristobalite and tridymite—two polymorphic forms of silica of lower specific gravity than quartz. This transformation is attended by a large increase in the volume of the product. It is therefore necessary that the firing be sufficiently drastic to reduce the expansion in industrial usage to a minimum. Further, such heat treatment results in the formation of a network of acicular crystals embedded in 5 to 15 p.ct. of vitrified matrix—a structure possessing considerable stability under loads at high temperatures. On the other hand, a fireclay product is, in the main, a vitrified mass containing only a comparatively small percentage of a crystalline substance known as mullite ($3Al_2O_3.2SiO_2$). The structural stability of such a product is obviously a function of the rate of change of viscosity of the "glass-like" mass in the circumstances of particular testing or usage.

This fundamental difference in constitution is well indicated in the results of the refractoriness-under-load test. In this test, a piece of definite size and shape is subjected to a certain load, usually 50 lbs. per sq. in., and its temperature raised at the rate of 10° C. per minute. Changes in the length of the test piece, together with the temperature, are continuously recorded. A superior silica brick, under a load of 50 lbs. per sq. in. and in the circumstances of the test may show no appreciable subsidence up to temperatures in the neighbourhood of 1650°, when rapid collapse will take place. A fireclay product may start to show a gradual subsidence between 1200° and 1250°, with a fairly rapid collapse between 1350° and 1400°. A "pocket-sand" siliceous product possesses structural stability under this load up to temperatures between 1530° and 1600° C. After being tested at high loads, the silica brick, after collapse, usually shows a shear fracture, whereas, in this test, the fireclay product tends to squat. Circumstances of manufacture, including the mixing and grading of the raw materials, the firing treatment, and the grog (pre-fired clay) content of a fireclay product, cause appreciable variation in these figures and indications, which must, therefore, be taken as average data. Nevertheless, they emphasize (1) the contractile nature of fireclay products in comparison with silica goods, and (2) the remarkable structural stability of silica products.

The "silica firebrick," the basis of which is the "pocket sand" found mainly in isolated pits in the carboniferous limestone of Derbyshire, falls between the two aforementioned categories of common refractories. By blending the sands, a mixture containing between 91 and 92 p.ct. of SiO_2 and an average of 10 p.ct. of "theoretical" clay matter is obtained on firing. This product "matures" in the neighbourhood of 1430°, and a comparatively rigid matrix, in which some silica has been dissolved, and afterwards re-precipitated as cristobalite, is formed. This product is, therefore, mainly composed of crystalline constituents, and when properly developed shows comparatively high under-load values. Thus, a hard-burned product shows no signs of failure in the normal test, at 50 lbs. per sq. in., until a temperature of approximately 1600° C. is reached.

PHENOMENA OF EXPANSION AND CONTRACTION, AND THEIR INFLUENCES.

Those changes which occur during the firing of refractory materials belong to a class known as arrested reactions. In these, the chemical and physical changes are arrested at particular and definite states before they are completed. Thus, it is well to recognize that the constitution of a refractory tends to alter during industrial usage. In some cases, this alteration is very drastic; and, because of the attendant volume changes, serious consequences result.

The behaviour of a straight silica product during its preliminary heating and subsequent usage is somewhat complex, for we have to consider (1) the normal reversible thermal expansion, (2) those reversible expansions taking place at certain definite low temperatures and due to polymorphic changes in the cristobalite, tridymite, and quartz, and (3) an irreversible expansion due to the constitutional alterations of quartz to cristobalite and tridymite. The second class is known as inversion, and may be written as follows:

$$\alpha \text{ quartz} \underset{575^\circ \text{ C.}}{\rightleftharpoons} \beta \text{ quartz}$$

$$\alpha \text{ cristobalite} \underset{225^\circ}{\rightleftharpoons} \beta \text{ cristobalite}$$

$$\alpha \text{ tridymite} \underset{117^\circ}{\rightleftharpoons} \beta_1 \text{ tridymite} \underset{163^\circ}{\rightleftharpoons} \beta_2 \text{ tridymite}$$

These changes are associated with very appreciable volume alterations, the largest of which—the α-β cristobalite change—may amount to 3 p.ct. of the original volume of the brick. Since these changes take place rapidly, they can readily introduce strains into the refractory structure, with consequent weakening, and sometimes with disintegration. It is evident, then, that the initial heating of a setting must be conducted with extreme caution until a temperature of 650° to 700° C. has been reached. Thermo-couples and thermometers are necessary for the careful regulation of the rate of rise of temperature.

Most silica products as supplied to industry undergo some constitutional change during high temperature usage which results in a permanent expansion. This, of course, is due to the conversion of residual quartz to the "lower specific gravity" forms of silica. Naturally, in manufacture, every endeavour is made to reduce this factor to a minimum. Nevertheless, unless great care is taken, and allowances are made for expansion, definite strains will be set up in the retort structure, with consequent liability to loss of retort contour and, in some cases, actual failure. Further, it must always be borne in mind that in most phases of carbonizing there are appreciable temperature gradients existing in the refractory structure during use. Consequently, any conversional changes will necessarily be unevenly developed, with a resultant increase in the involved strains. After-expansion test data obtained by heating test pieces to 1500° C. for two hours give an admirable guide. Such values should not exceed 0·3 p.ct. for highest-

grade silica products. Further, by measuring the expansion of test pieces up to 1350° during the under-load testing experiments valuable information respecting the probable expansion of a retort during its initial heating can be realized. For a highly converted "straight" silica product, values between 1·1 and 1·3 p.ct. for the expansion up to 1350° are obtained. Such figures, taking into consideration certain other factors, correspond to a vertical expansion of about 3·5 to 4 in. on a standard Glover-West retort—an amount usually found when "straight" silica bricks are used in construction.

When fireclay bricks are burned, the fluxes melt, and dissolve some of the less fusible materials, binding the whole more or less firmly together. A certain amount of contraction occurs during this operation, and, if not reduced to a minimum during the firing, it will continue when the brick is in use. Most "aluminosilicate" refractories are, in essence, contractile. Therefore, their use in modern vertical retorts is limited, for the maintenance of the contour of a retort is of primary importance.

With the "pocket-sand" silica product there is an approximation to volume constancy, except, of course, for the normal thermal expansion. There is, to some extent, a balancing of the contractile properties of the clay portion with the expansive results of quartz conversion. The net result of these opposing properties depends upon the temperature and the load, but, in retort work, there is a slight tendency towards an irreversible expansion. This is all to the good. During the initial heating, a Glover-West retort constructed of the "pocket-sand" product shows a vertical expansion of about 3 in.

Influence of Carbonizing Conditions on the Retort.

In studying the various influences militating against the economical life of a retort, it is advisable to bear in mind (1) the limitations in the properties of the refractories under general carbonizing conditions, (2) the individuality of the carbonizing system, (3) probable local peculiarities in operation, and (4) the nature and influences of the coal used. The assessment of the major of these factors in causing uneconomical service in a particular installation is a very important task which should be carried out in all cases of trouble; the main data and conclusions being carefully filed.

Examinations of retorts in working and during final dismantling show that there are a number of features in the condition of retort brickwork which are common to most types of gas-making systems. The associated phenomena, which should form the basis of organized research problems, are mainly connected with the influences of coal, coke, gaseous and volatile substances, and thermal strains on the refractory materials under the particular conditions of carbonization. There are other features which are peculiar to the individuality of the carbonizing system. Most contractors for carbonizing plants, by means of carefully conceived investigations, endeavour to understand the mechanism of such "individual" phenomena, for the removal of such deleterious influences naturally means increased efficiency. Both the physical state and the constitution of coal have decided effects on carbonization in general, and on the life of the retort in particular. This is so, since the requirements for the effective carbonization of different coals vary considerably. Hence complete data concerning the coal are necessary in adjudicating the value of a refractory in a gas installation.

In continuous vertical retort work, one ideal is the continuous, unhampered descent of the charge through the retort. The charge is thus progressively heated until finally it is resolved into coke. At the bottom of the retort, the red-hot coke is usually "steamed," with the object of increasing the over-all efficiency of the process. In these circumstances, it is obvious that the surface temperature and condition of the coking side of the retort are influenced by the nature of the charge at specific zones. Consequently, it is only to be expected that the condition of vertical retorts of a particular system should show zonal effects. The problem is to reduce the deleterious influences of these zonal effects to such a minimum that the retort setting will show an economical life. It is therefore pleasing to be able to state that the makers of vertical retorts continue to give increasing attention to these zonal phenomena. Furthermore, they embody the results of much successful work in their more modern plants.

In modern vertical retorts, the refractory material is either a "straight" silica or a highly siliceous product. Reasons for this preference have already been given. However, from the constitution of such products, certain troubles must be anticipated, though, of course, careful manufacture of the bricks may reduce them. Strains can be set up in a refractory structure during usage by (*a*) temperature variations, (*b*) alterations in the nature and constitution of the refractory, (*c*) the deposition, sometimes followed by the crystallization or solidification, of foreign substances in the pores of the bricks, or (*d*) a combination of such circumstances. In the upper portions of vertical settings, spalling—*i.e.*, trouble due to temperature fluctuations—is sometimes encountered. Silica products are particularly prone to spalling both at low and at high temperatures. Consequently, where temperature fluctuations are likely, the splitting and cracking of the corners of retort shapes may be experienced. It has already been pointed out that alterations in the crystalline constituents of a silica product by reason of the associated volume changes may result in spalling. Besides this, however, high temperatures must influence the nature of the amorphous substance or matrix. With such continued heat treatment, more "glassy" material, which is more liable to the influence of embrittling agencies, is formed. There are few or no data defining this alteration, but the examination of retort settings after service confirms the existence of this phenomenon.

Foreign substances, such as iron compounds and alkalis, pass from the coal and find their way into the pores of the refractory. This penetration is often in the gaseous or volatile form, being followed by the deposition and, in some cases, either the crystallization of a solid or an interaction with the constituents of the refractory. Such impregnations often give rise to severe and highly localized strains in the interior of the mass, forming a multitude of minute cracks, which may eventually cause localized surface disintegration. The disease is often masked by other attendant operational influences, which themselves accentuate failure. Nevertheless, it is often the first circumstance in an ultimate failure.

During scurfing, at certain zones in a vertical retort portions of the refractory are sometimes dislodged. A number of explanations may be put forward to account for the trouble, and each one may possess something of the truth. There can be no doubt that where scurf is burned off by the admission of air, localized high temperatures, owing to rapid combustion, often result. The surface in contact with the scurf has probably been weakened, at definite planes, by (1) depositions and impregnations, (2) constitutional changes of the silica in the surface layers of the retort resulting from previous high-temperature scurfings, and (3) a general spalling tendency of the refractory. Thus the influence of such periodic high temperatures, besides embrittling the surface, may easily disintegrate an already weakened material. In connection with the influence of impregnations, it is interesting to note that W. T. Gardner* has reported an investigation of the failure of some retorts, which had become unworkable owing to surface roughness. Gardner states that this condition had been brought about by the use of salty coals. Analyses of the "glassy" surface revealed the fact that the alkali content had increased from 0·54 p.ct. in the original brick to 3·8 p.ct., and the "iron" (as Fe_2O_3) from 1·50 p.ct. to 2·8 p.ct. The salt content of the coal used was approximately 0·3 p.ct. W. J. Rees† has traced a case of spalling in a silica horizontal retort to the disintegrating influence of an impregnation. An investigation of certain "blackened" patches showed the existence of iron oxide together with the deposition of carbon. Rees concluded that the presence of iron oxide facilitated the decomposition of carbon monoxide with the deposition of carbon and the consequent weakening of the structure.

Depending on the temperature and nature of the atmosphere, the "iron" which passes from the charge to the refractory exerts either a superficial disintegrating action or a corrosive influence. Where the temperature is sufficiently high, fusible silicates may be formed. These, depending on the temperature, porosity, and nature of the matrix of the brick, will tend to diffuse into the brickwork, with the possibility of causing "holing" and ultimate failure. The nature of the atmosphere is important, for steam is a highly effective reducing agent, which intensifies the slagging and eroding action of iron oxide. The atmosphere in a gas retort is complex and variable, but such reducing influences can be anticipated. Further, the gases often take selective paths by way of the wall in vertical retort work—a fact which must accentuate the action of the atmosphere on the surface. When the surface has thus been rendered more or less viscous, erosion can readily take place. It is very fortunate that silica products have the property of absorbing appreciable quantities of ferruginous slags and dusts without noticeable loss of structural stability. It would seem that, though iron compounds impregnating a silica product may have attacked or combined with the matrix, the interlacing skeleton of silica, mainly in the form of tridymite and cristobalite, may be unaffected. In these circumstances, the product will probably possess definite structural stability. Thus, until the bulk of the silica has passed into solution, the refractory will remain a structural entity.

Many cases of the "holing" of retorts start at the joints. In fact, the predisposition of jointing cements to start failure has often been the subject of comment. It would appear that once a joint is sufficiently opened to allow an appreciable gas leak, the escaping gas, under certain conditions, may burn in the combustion chamber with an intense heat, which, finally, causes fusion of the refractory. This action can be augmented by the presence of ferruginous or other deposits in the vicinity of the flame. Undesirable short, sharp flames in the combustion chamber, when deflected on to the retort brickwork, may cause a much more rapid diffusion of the "iron" from the coking side to the combustion chamber side, with resultant "holing." In these cases, however, it is obviously necessary to define a local circumstance.

Because of the possibility of trouble from inadequate joints,

* Trans. Ceram. Soc., **25**, 471, 1926.

† W. J. Rees, Trans. Ceram. Soc., **25**, 321, 1926.

the quality of the cements is of the utmost importance. Present-day knowledge respecting such materials is not very extensive. Consequently, they vary considerably in constitution and effective properties. From first principles, it is apparent that the cement must be uniform in texture, finely ground, and should possess a certain plasticity to enable very thin joints to be made. Many cements contain a minimum of clay in order to realize workability. According to some observers, it is this clay content which serves to start trouble (1) by the attack of slag-forming agencies, and (2) by contraction. A careful study of the whole problem indicates that some compromise is necessary. It would appear that, if a cement is capable of forming and maintaining the whole retort as a monolithic structure under working conditions, the results, as far as the cement is concerned, will be very desirable. If, however, it contracts in its vitrification, leaving fissures and the like, the retort is predisposed to failure. The zonal nature of vertical retort working, which has already been emphasized, certainly suggests that the constitution of a cement must vary with the zone of the retort. It is along these lines that progress in this matter is likely to be made.

Conclusion.

It is hoped that this inadequate survey has at least indicated the necessity for continued research into the problems of the manufacture and utilization of refractory materials for gas-works. The ideal of such industrial research is, surely, intensive collaboration. Though the work of research associations is a great and necessary help towards the solution of the problems, the collection and collation of data by the technical staffs of contracting firms and individual gas plants are usually vital to a successful issue. Truly the problem of refractories for gas-works will only be satisfactorily solved by the application of the ideal of mutual help as essential to industrial progress.

Finally, the author wishes to thank West's Gas Improvement Company for permission to use some of the data quoted in this lecture, and for much help.

Discussion.

The PRESIDENT remarked that Mr. Green had given them a complete synopsis of the information available on the subject of refractories—particularly silica—and they were all extremely indebted to him for the lucid manner in which he had presented the case. The lecturer, who had undoubtedly thrown a new light on the matter, had emphasized the importance of the chemical changes which took place during the working of carbonizing settings generally, and the need for careful attention. However good the supply of refractory materials might be, careful supervision was necessary, and only the very best workmanship would ensure proper results. Mr. Green had dealt with the subject of joints, and had forestalled what he (Mr. Kenshole) intended to say on this matter. One thing, however, he thought he might mention; and that was that in the Glover-West retorts at Lea Bridge, all the sections were ground to fit in the dry state before any jointing material was introduced. The lecturer had stressed the importance of employing thin joints. This was a matter which had received careful attention, and which undoubtedly would have impressed itself on their minds.

A Battery of Questions.

Mr. T. H. PRATER (Isle of Thanet Gas Company) said that no one would criticize Mr. Green's lecture; but he would be glad if the lecturer could give him information on one or two points. The first related to the use of silica. He (the speaker) was under the impression that the present trend of enthusiasm towards the employment of silica might not last very long; for to his mind the disadvantages outweighed the advantages. With regard to the expansion of silica, did this continue for a considerable period during working, or was it terminated with the initial firing of the material supplied? His experience tended to the belief that it might continue for two or three years. Then there was the question of patching silica retorts. What was the effect of patching on the structure as a whole; and what was the normal retort load? Mr. Green's observations on the absorption of iron oxide by silica were of great interest; and he (the speaker) had been pleased to hear the lecturer say that he had tested a piece of silica which was almost saturated with iron oxide, and had found that the stability of the material was practically unaffected. There was another point. What were the views of the lecturer regarding the practice of scurfing retorts by the water gas reaction? Mr. Green had given the impression that in all matters relating to refractory materials, some compromise was necessary. Did he therefore suggest that retorts constructed of siliceous material, instead of silica, would give the best all-round results?

Silica Essential for High Temperatures.

Mr. GREEN, replying to Mr. Prater's first question regarding the relative merits of silica and fireclay material, said that the latter was by no means finished for low-temperature working. One had, however, to view the matter with an open mind; and it was a fact that there appeared to be a trend towards the employment of higher temperatures for carbonization. For high temperatures, silica was essential, for the simple reason that fireclay could not stand up to its duties. With regard to the matter of expansion in use, this was largely a question of the nature of the product supplied. In some cases, the silica would not continue to expand in use; other deliveries might show after-expansion after three or four months' working. The patching of silica retorts caused a certain amount of consternation; and personally he would not guarantee that in all cases patching would be successful. To patch a matured material was similar in essence to putting new cloth into an old garment. In some cases the latter would stand the strain; in other instances, the results might not be so successful. Mr. Prater had raised the question of the normal retort load. In practice this was in the neighbourhood of 15 lbs. per sq. in.; and any test above 25 lbs. per sq. in. would give a good indication of structural stability. His remarks were based on a load of 50 lbs. per sq. in.—which figure, of course, was that of the Institution of Gas Engineers' specification. The next point to which Mr. Prater referred related to the scurfing of retorts; and with regard to this he (Mr. Green) would say that the scurfing of retorts by the water gas reaction was a matter at present under investigation. From the theoretical point of view, the reduction in temperature brought about by the water gas reaction was to the good; but it had to be remembered that many other factors and influences had to be taken into consideration, and he would not go so far as to say that the scurfing of retorts by the water gas reaction was the be all and end all of the scurfing problem. The final point which Mr. Prater had raised was in regard to whether he (Mr. Green) considered siliceous material as a satisfactory compromise. Personally, he thought it would be folly to assert that such a material was the best in every respect; but he did think it possessed a happy combination of features which led to the satisfactory operation of horizontal and vertical retorts—particularly the latter.

Replacing Bottom Sections of Vertical Retorts.

Mr. D. CLEAVE CROSS (Lea Bridge Gas Company), in regard to patching, said that the vertical retort, in actual working, was normally covered with carbon to the extent of two-thirds of its length; the bottom section—the remaining one-third—being practically free from scurf. Steaming took place, with consequent erosion; and he had found that the life of the bottom section of the retort was considerably less than that of the others. For instance, after the retort had been in operation for 900 days, it was discovered that it was holed and pitted, and so on; and by cutting-out the bottom sections, and "re-patching" with new material, the retort would stand operation for 1700 to 1800 days. In other words, the top sections of the retort would out-last two bottom sections; and consequently he thought that re-patching was unquestionably a paying proposition. With regard to the question of flaking, he had tested pieces of ordinary retort and flakes for specific gravity; and he had found that, whereas the specific gravity of the retort material was 2·59, that of the flake was 2·49. This pointed to a change in the material—a change, moreover, which was sufficient to account for an expansion difference of no less than 4 p.ct. on the outer film of the silica, and which might in turn account for some of the scaling. The scurf contracted at high temperatures, whereas the silica was expanding. Consequently, there was a sort of tearing action. During the scurfing action, temperature had a great influence; and West's Gas Improvement Company were recommending that lower temperatures should be employed in the scurfing period.

Mr. GREEN said that he agreed with the last statement of the previous speaker. Of course, one of the causes of flaking was the change which took place in the nature of the material in being changed from quartz to cristobalite. With regard to flaking, however, he had carried out tests which showed that there was comparatively little difference between the specific gravity of the flake and that of the retort material.

Scurfing of Retorts.

Mr. S. H. MILES (Reading Gas Company), referring to the observation of Mr. Cross that the bottom sections of the vertical retort showed the greatest signs of erosion, and consequently were the least durable portion of the entire retort, observed that at Reading they had arrived at a diametrically opposite conclusion. The flaking action was so bad that the life of the retorts was shortened considerably; and it seemed that, once this flaking action had commenced, nothing could stop it. The most serious erosion was in the top part of the retort. With regard to the question of steaming, was it possible to state to what limits steaming could be carried out without doing serious harm to the retort? To his mind, scurfing was at the root of many of their troubles. On this question there appeared to be two schools of thought. There were those who allowed the retorts to operate for eight or ten weeks before scurfing, and there were those who worked their retorts for thirty days only prior to scurfing. He would be glad to know what the lecturer's opinion was of the relative merits of the two methods. Finally, he (Mr. Miles) would be glad to hear what Mr. Green thought about the application of a varnish coating to the bricks. Had this any real value?

Mr. GREEN said that different conditions existed in different carbonizing units. For instance, he knew of a case where flaking was violent in the early life of a retort, and yet suddenly ceased; and no further trouble was experienced. He could not say to what limits steaming should be carried. As a matter of fact, this question was on the agenda of work which required investigation. It had to be remembered, of course, that steaming was a most efficient reducing agent for iron oxide. With regard to the relative merits of short-duration and long-duration scurfing, this depended largely on the particular installation; but it had to be borne in mind that the scurf became far more tenacious as the result of prolonged contact with the retort walls—in fact, it almost entered into the pores of the brick. He had no belief in the merit of coating a retort with a "varnish." When this was carried out, any violent changes in temperature naturally asserted themselves more on the glasslike material. Theoretically the idea was wrong.

Reversible Reactions.

Mr. A. G. GRANT (Gas Light and Coke Company) remarked that the author had emphasized the importance of the physical changes

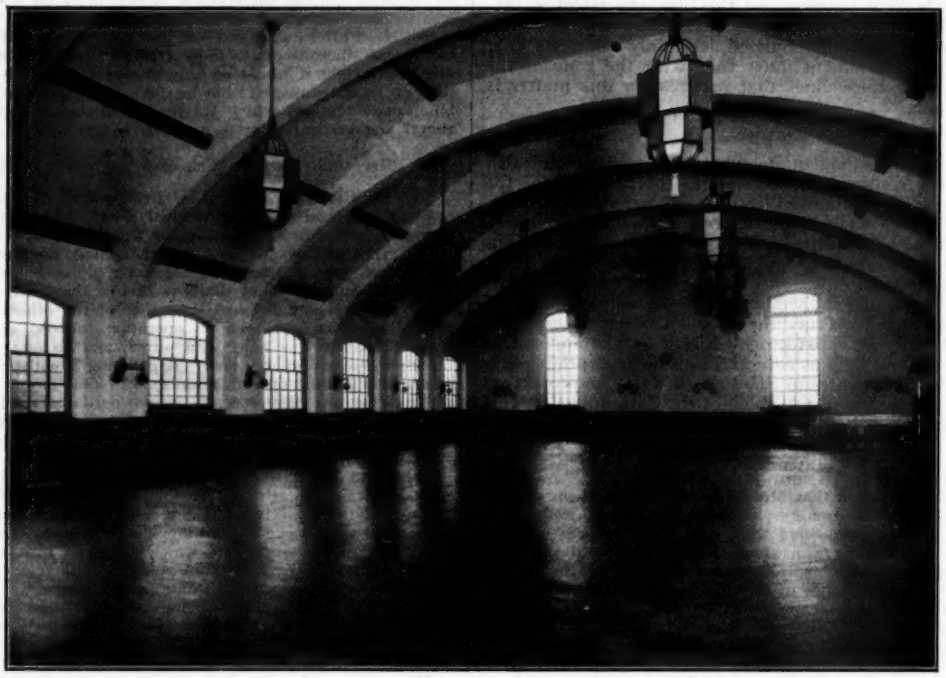
which occurred in silica material on being heated. Was he of opinion that, when the setting was being let down, reversion of the β cristobalite to the α cristobalite would take place? And in heating-up a setting for a second time, ought they to be very careful during the temperature rise of the first 200° C.?

Mr. GREEN replied that, when they were letting-down the setting, they ought to exercise the same care which they showed in heating it up. After red dullness, cooling should be carried out very carefully indeed. And, in heating-up the setting for the second time, equal attention was necessary.

VOTE OF THANKS.

Mr. PRATER proposed, and Mr. J. M. WEBBER (Croydon Gas Company) seconded, a vote of thanks to Mr. Green for his lecture; and the reply of Mr. GREEN brought the meeting to a close.

THE GAS LIGHT AND COKE COMPANY'S DINING HALL.



THIS spacious Dining Hall has just been re-opened after being in the hands of the decorators, under the supervision of the Architect, Mr. Austin Hall The hall, which is 110 ft. long by 60 ft. wide, is lofty and well lighted; it is used for staff dances, concerts, and other entertainments, and is an important factor in the social activities of the staff of the Gas Light and Coke Company. The illumination of the building is, of course, by gas, and the main heating of the hall is by means of fourteen John Wright & Co.'s "St David" gas-heated radiators, fitted on marble bases. There are also two John Wright's "Raphael" fires, which have been fitted with reeded backs specially designed by the Architect

REGISTER OF PATENTS.

Carburetted Water Gas Making.—No. 299,482.

DVORKOVITZ, P., of Kensington.

No. 11,272; April 27, 1927.

The patentee claims, in the process of manufacturing carburetted water gas wherein water gas is enriched and its calorific value increased by mixing therewith an oil gas, the step of producing a fixed oil gas in a gasifier provided with heating means, whereby the oil supplied thereto is subjected to and maintained at a predetermined regular temperature such as will produce the required gas and leave a valuable tar as a residue, and subsequently mixing the produced oil gas with the water gas in such proportions that the mixture will give the amount of thermal units required.

Water Gas Manufacture.—No. 299,485.

NIELSEN, H., of Muswell Hill, and LAING, B., of Petty France, S.W. 1.

No. 14,030; May 28, 1927.

The invention relates to the manufacture of water gas, more particularly from powdered or finely divided bituminous materials. When dealing with such material, a very shallow fuel bed is required in order not to present too great a back pressure in the fuel bed itself. Consequently the amount of heat which can be stored up in the fuel bed is insignificant—a fact which has hitherto hindered the employment of such cheap materials for water gas production. The present invention has been evolved in order to overcome this objection.

According to the invention an auxiliary material, such as firebrick or other refractory material, is made use of in order to store up the heat which is required for the endothermic water gas reaction; and during the "run" the carbonaceous material, together with the necessary volume of steam, is brought into contact with the highly heated refractory material.

Burner Regulator.—No. 299,559.

HARPER, J., & CO., LTD., of Willenhall.

No. 22,432; Aug. 26, 1927.

This invention has for its object to provide an improved construction of injector which more completely and effectually disintegrates the gas passing therethrough. There is provided a perforated tube closed at its ends and furnished with means for endwise adjustment. The tube is laid centrally within a cylindrical chamber into which the gas is received from the supply and, passing out from such chamber at one end, enters another chamber, which acts as the expansion chamber; the partition between the two chambers being formed by an internal collar.

Pressure Regulator for Street Lamps, &c. No. 299,573.

BECKER, A. C., of Berlin-Charlottenburg.

No. 24,095; Sept. 13, 1927.

This invention relates to gas pressure regulators for street lamps, house connections, apartment connections, and the like, and has for its object to provide an improved construction.

The improved regulator is of the kind with which the consumption pressure is regulated by means of a membrane, carrying a valve, and is characterized by the feature that both the inlet and the outlet of the regulator are on the same side of the main membrane, which is influenced on one side on its entire surface by the consumption pressure, on the other side on one part of its surface by the pressure of supply, on another part of its surface by the consumption pressure, and on a third part of its surface by atmospheric pressure.

The proposed regulator as compared with the known kinds of construction is distinguished, says the patentee, by the following features and advantages: It requires less space; small cost of manufacture; great reliability and continuous correct functioning; avoidance of all rods and intermediate levers with pivots; and the consumption pressure remains exactly the same even when the pipe distribution pressure is raised or reduced within very wide limits.

Further advantages are mentioned; and the regulator is described in great detail, illustrated, and covered by fourteen claims.

Sulphate Manufacture.—No. 299,934.

ROBSON, S., of Avonmouth.

No. 21,623; Aug. 16, 1927.

The process of this invention is an adaptation of the methods described in specification No. 289,950 [see "JOURNAL," Vol. 182, p. 728] to the production of sulphate of ammonia from crude ammoniacal liquors, such as gas-works liquor; an object of the invention being to avoid on the one hand the employment of liquid sulphuric acid and on the other hand the necessity for separating the salt from a liquid and subsequently drying it.

With this object in view, the invention comprises distilling the crude liquor to obtain a distillate substantially free from non-volatile nitrogen compounds, concentrating the distillate, if necessary, to an NH_3 content of above 6 p.ct., volatilizing the distillate at a temperature such that the relative proportions of NH_3 gas and water vapour in the resulting gaseous mixture are correct for combination with sulphur trioxide to produce substantially dry neutral sulphate of ammonia, and bringing together the gaseous mixture and sulphur trioxide to produce such sulphate of ammonia directly in one operation.

The gaseous mixture of ammoniacal vapour and water vapour obtained on distillation may be conveniently mixed with the sulphur-bearing gases by admitting the two gas streams simultaneously to a suitable chamber. The temperature necessary to ensure this may be ascertained by determination of the partial vapour pressures of ammonia and water over various strengths of liquid at various temperatures.

The salt may be collected by passing the gases through bag filtration devices, electrostatic depositors, or other plant.

As an example of the process, crude ammoniacal liquor is distilled to approximately 10 p.ct. NH_3. The distillate is continuously fed through a still where temperature conditions obtain such that in the vapour passing forward the ratio $NH_3 : H_2O$ is slightly higher than 2 : 1. This vapour is mixed with the SO_3-bearing gases from a sulphuric acid converter or contact chamber in the manner described in specification No. 289,950 to produce substantially dry neutral sulphate of ammonia. Control is maintained by ensuring that the gases passing to the baghouse or other collecting device are slightly alkaline and, in the case of baghouse collection, that the exit gases do not fume—which latter will be the case should the water be in excess of the SO_3, or *vice versa*.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for Nov. 28.]

Nos. 33,819—34,697.

ALLEN, W.—"Stands for gas-heated devices." No. 34,690.
BARTLETT HAYWARD CO.—"Gas washers." No. 34,219.
BARTLETT HAYWARD CO.—"Liquid and gas contact apparatus." Nos. 34,220, 34,221.
BECK, K.—"Safety device for gas burners." No. 33,874.
BROADHEAD, R. W.—"Gas scrubbers." No. 33,957.
DEUTRICH, J.—"Gas meters." No. 34,282.
GLOVER, W. T.—"Gas meters." No. 34,577.
ILLINGWORTH CARBONIZATION CO., LTD.—"Apparatus for carbonization of coal." No. 34,563.
ILLINGWORTH, S. R.—See Illingworth Carbonization Co., Ltd. No. 34,563.
JACKSON, L. MELLERSH-.—"Self-sealing doors for coke ovens." No. 34,266.
JENSEN, C. A.—See Bartlett Hayward Co. No. 34,219.
KENDRICK, H. B.—"Control of plant for carbonization of coal." No. 33,956.
KOPPERS CO.—See Jackson, L. Mellersh-. No. 34,266.
MCINDOE, R. W.—"Gas meters." No. 33,963.
METERS, LTD.—See Glover, W. T. No. 34,577.
STEVENSON, W.—"Regenerative process for gasification of powdered coal." No. 33,988.
TAUNTON, R. P.—See McIndoe, R. W. No. 33,963.
TERRELL, R.—"Incandescent gas mantles." No. 33,968.
WALTERS, A.—"Coke oven doors." No. 34,487.
WEST'S GAS IMPROVEMENT CO., LTD.—See Kendrick, H. B. No. 33,956.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Special Orders.

The Bristol and Sheffield Gas Orders were approved by the House of Lords, on the motion of the Earl of Plymouth, on Nov. 28. The Ipswich Gas Order was laid before the House on the same date, and referred to the Special Orders Committee. Special Orders proposed to be made on the applications of the County Borough of Burnley and of the Petersfield and Selsey Gas Company are also before the House.

HOUSE OF COMMONS.

Gas Legislation.

Mr. MARDY-JONES (Labour M.P. for Pontypridd) asked the President of the Board of Trade if the Government intended to introduce legislation during the present session to abolish the many obsolete restrictions which were hindering the development of the gas industry.

Sir PHILIP CUNLIFFE-LISTER gave the usual reply, to the effect that there was no time this session.

Mr. JONES, however, pressed the matter further, and asked if the Department was fully alive to the need for the withdrawal of these restrictions, and, in view of the fact that the gas industry was such a large consumer of coal, whether it would not facilitate the development of the coal industry to have these restrictions removed.

Sir PHILIP CUNLIFFE-LISTER replied that, as he had been working on it for the last two years, he was probably more alive than almost anyone to the need for some legislation, but the whole field covered by the different problems involved matters which would inevitably lead to a great deal of discussion. Some of them would probably be controversial, and it would not be possible to deal with them at a time when there was no opportunity for full Parliamentary discussion.

Mr. JONES again urged that, in view of its importance, this legislation should be expedited.

Sir PHILIP replied that it did not rest with him, nor with the Cabinet, to expedite it, as time was inevitably taken up in discussions on large measures.

Mr. WILL THORNE then asked if Sir Philip would speed up the Committee who had the matter under consideration with a view to bringing up some kind of recommendation; and if they did bring up a recommendation to wipe out these restrictions, he asked if the Government would give consideration to the matter.

Sir PHILIP replied that they would. The National Fuel and Power Committee were proceeding as fast as they could, and he would probably receive their report on Nov. 27. The question divided itself into matters which were controversial and those which were not, and naturally he could not commit the Government at this stage without discussion to any matters which were not entirely settled by common consent.

A similar question by Major Steel (Conservative M.P. for Ashford) met with a similar reply from the Board of Trade.

Special Orders.

The Bristol and Sheffield Gas Orders were approved by the House of Commons on Nov. 29.

NOTICES GIVEN OF BILLS (SESSION 1929) RELATING TO GAS, &c., UNDERTAKINGS.

Notice has been published of the intention to promote in the 1929 Session of Parliament the following Bills containing clauses having reference to gas undertakings.

Aldershot Gas, Water, and District Lighting Company.—To extend the gas limits of the Company; to repeal the rights and obligations of the Godalming Gas and Coke Company, Ltd., in the area concerned; to change the name of the Company; to make new provisions as to the issue or sale of capital; and for other purposes.

Gas Light and Coke Company.—For the acquisition by the Company of the undertakings of the Grays and Tilbury Gas Company and the Pinner Gas Company; to provide for differential prices in the areas now supplied by these Companies; to make provisions as to borrowing powers; and for other purposes.

Ilkley Urban District Council.—To confer further powers upon the Council in connection with their gas undertaking.

Newcastle-upon-Tyne and Gateshead Gas Company.—For the application of the principle of a basic price and a basic rate of dividend; to provide for the laying of mains outside the limits of supply; to grant further powers with reference to issue of capital; to make provision for profit-sharing, and as to price of gas for public lighting; and for other purposes.

Newport (Salop) Urban District Council.—To make provision in regard to the supply of gas by the Council as from the date of vesting in the Council of the undertaking of the Newport Gas Light and Coke Company, Ltd.; to extend the gas supply limits; and to enable the Council to borrow further money.

Romford Gas and Coke Company, Ltd.—For the dissolution of the Company and re-incorporation of a new Company.

Royal Victoria and Other Docks Approaches.—Among other things, to empower the acquisition by the London County Council, or the West Ham Corporation, and demolition and removal, of a bridge of the Gas Light and Coke Company carrying the mains of that Company over the River Lee, and of certain mains.

Sheffield Gas Company.—This is a Consolidation Bill, re-defining the limits of supply, and defining or re-defining the lands on which the Company may manufacture or store gas or deal with residual products.

Smethwick Corporation.—Among other purposes, for securing a supply of gas to working-class houses.

Southport Corporation.—Among other matters, for further provisions in regard to the Corporation's gas undertaking, including the supply of stoves, engines, and fittings for the consumption of gas, coke, and smokeless fuel; the supply of smokeless fuel; the regulation of geysers; and other matters.

South Suburban Gas Company.—To extend the limits of supply; to repeal the rights and obligations of the Northfleet and Greenhithe Gas Company, Ltd., in the area concerned; and to transfer to the Company the gas undertaking of the Northfleet Company.

Wandsworth, Wimbledon, and Epsom District Gas Company.—For the conversion of stock; to prescribe a basic price of gas and basic rate of dividend; to make or amend provisions as to prepayment meters and gas supplied thereby, and as to testing, sale, measurement, and price of gas and incidental matters; to confer upon the Company further financial powers; to authorize the Company to construct gas-works on scheduled land; and for other purposes.

Winchester Water and Gas Company.—To define the gas limits of supply of the Company, and to extend these limits; to use scheduled lands for gas purposes; to make further financial provisions; and to confer other powers upon the Company.

Windermere Urban District Council.—To empower the Council to acquire the undertaking of the Windermere District Gas and Water Company; to authorize them to borrow money; and for other purposes.

Yorktown (Camberley) and District Gas and Electricity Company.—To provide for the transfer to the Company of the gas undertaking of the Borough of Wokingham; to extend the limits of supply; to authorize the Company to make agreements with other companies in relation to the use or benefit of the Company's plant or organization.

LEGAL INTELLIGENCE.

DUNDALK GAS COMPANY'S VALUATION APPEAL.

(Before the CHIEF JUSTICE, *Mr.* JUSTICE FITZGIBBON, *and Mr.* JUSTICE MURNAGHAN.)

Reserved judgment was delivered in the appeal by the defendant in the case of the Dundalk Gas Company *v.* Commissioner of Valuation from a unanimous decision of Mr. Justice Sullivan and Mr. Justice O'Byrne, in the High Court, affirming an order of Circuit Judge Doyle with regard to the rateable value of the Dundalk Gas Company's undertaking for the purpose of assessment. The Court dismissed the appeal of the Commissioner of Valuation, with costs, upholding the decision of the Judges in the High Court.

It appeared that the Circuit Court Judge had assessed the rateable value of the Gas Company's buildings at £306, and the rateable value of laying and using the gas mains under the streets and roads of the urban district of Dundalk at £217, making a total of £523, holding that he was bound under Section 7 of the Annual Revision of Rateable Property (Ireland) Amendment Act, 1860, as applied to a gas undertaking, to exclude from valuation not only all machinery operated by motive power, but also all productive apparatus forming the equipment, or part of the equipment, of the factory, the manufacturing effects of which were produced independently of motive power. Adopting the "profits method" of ascertaining the valuation of such undertakings, Judge Doyle was of opinion that, in order to become the subject-matter of valuation under Section 7, an apparatus must either be an integral portion of the building in which the manufacture was carried on, or a machine for the production of motive power.

The grounds of the appeal from the Circuit Court were that the Judge had misdirected himself, and was wrong in law in holding that Section 7 of the Annual Revision of Rateable Property (Ireland) Amendment Act, 1860, applies to a gas undertaking; in holding that Section 7 of that Act applies to the buildings of a gas company in which the gas is produced; in holding that Section 7 applies to the easements forming part of a gas undertaking; in holding that the expression "machinery" in Section 7 includes not merely all machinery operated by motive power, but also all productive apparatus forming the equipment, or part of the equipment, of a manufactory, the manufacturing effects of which are produced independently of motive power; in holding that under Section 7, in order to become the subject-matter of valuation, an apparatus must be an integral portion of the building in which the manufacture is carried on, or a machine for the development of motive power; in holding that he was bound to exclude from valuation under the section all machinery operated by motive power, and also all productive apparatus forming the equipment or part of the equipment of the undertaking of the Dundalk Gas Company, the manufacturing effects of which are produced independently of motive power; in applying the "profit method" of ascertaining the rateable values both of the buildings and the easements, while holding that the gas-works came within the provisions of Section 7; and in assuming that the application of Section 7 to particular apparatus necessarily determines that such apparatus is "tenant's capital" for the purpose of a valuation arrived at by the "profits method."

The total valuations originally appealed against by the Gas Company amounted to £965; the grounds of the appeal being that the valuations were excessive and did not represent the annual value of the premises—having regard to the rent at which one year with another they might in their actual state respectively be reasonably expected to let from year to year, the probable average annual cost of repairs, insurance, and other expenses necessary to maintain the hereditaments in their actual state, all rates and taxes and public charges being paid by the tenant.

In the considered judgment which was delivered by Mr. Justice FitzGibbon, the Court dealt fully with the various points raised in the grounds of appeal, and affirmed substantially the findings of the High Court Judges and the Circuit Judge, being unanimously of opinion that they were correct, and that the appeal must be dismissed with costs.

The appeal was accordingly dismissed with costs.

GAS FIRE LITIGATION.

John Wright & Eagle Range, Ltd., v. General Gas Appliances, Ltd.

The Court of Appeal on Wednesday, Nov. 28, reserved judgment in the appeal by John Wright and Eagle Range, Ltd., of Essex Works, Aston, Birmingham, against a decision of Mr. Justice Maughan, in the Chancery Division, in favour of General Appliances, Ltd., of Guide Bridge, Manchester. The litigation occupied fourteen days before Mr. Justice Maughan, and eight days before the Court of Appeal, and concerned a claim by the plaintiff Company for an injunction and damages for alleged infringement of their patent—granted to Mr. James H. Yates in 1913—of a certain gas fire. Mr. Justice Maughan refused the injunction, and dismissed the action with costs, on the grounds that the plaintiffs' claims were, among other things, too wide to be supported.

MISCELLANEOUS NEWS.

STOCKPORT GAS TRAGEDY.

Entire Family of Six Dead.

An entire family of six people was asphyxiated, and eleven people of two other families were admitted to hospital suffering from the effects of gas poisoning, as a result of fumes from a leaking street gas main penetrating into a block of houses in Sheffield Street, Heaton Norris, in the early morning of Friday, Nov. 30.

The victims were Arthur Baker (36, a labourer), his wife, and their four children. The people in hospital are reported to be making satisfactory progress, though the condition of one is serious.

THE DISCOVERY.

The scene of the tragedy is a block of six houses in Sheffield Street, one of Stockport's characteristic steep gradients. The discovery was made about six o'clock in the morning, when Mr. Walter Kneen, roused by the family next door, summoned the police, who forced an entry into the Baker home. Mr. Baker was found in an attitude which suggested that he had been attempting to save his family before he was finally overcome by the fumes.

In the street there was a strong smell of gas, and it was soon realized that the fumes were escaping from the pavement immediately in front of the Baker home. Excavations were made by workmen from the Gas Department, and the discovery was made of a crack in the 2-in. cast-iron main, which was quickly repaired. Close to the fissure in the main there was a hole in the wall of the Bakers' house a few inches below the pavement level; and it was probably through this that much of the escaping gas percolated into the three houses.

POSSIBLE CAUSE OF LEAKAGE.

Mr. T. Wiggins, the Gas Engineer to the Stockport Corporation, at first suggested that vibration set up by heavy traffic might have damaged the main, but later said he could offer no definite explanation until he had completed his investigation. It is possible, however, that a slight subsidence may be a contributory cause, for the property is built on a sharply sloping street, under which runs, not far away, a railway tunnel.

Mr. Kneen, who had summoned the police, awakened about 2 a.m., and noticed a smell of gas; but having satisfied himself that all the taps were turned off in his own house, he retired to bed again. Neither he nor his family were much affected by the fumes, most of the escaping gas settling in the Baker home and the two houses between which it stood.

Dr. Worthington, the police surgeon, who was called to the scene shortly after the discovery, made an examination of the bodies. It was stated that the six bedrooms of the three tenements had to accommodate 18 people.

The Coroner's inquiry, which was opened the following morning, was adjourned until next Tuesday.

INAUGURATION OF TULLY PLANT AT ELGIN.

On Nov. 23 Mrs. Wittet, wife of Lord Provost Wittet, officially opened at the Elgin Gas-Works an auxiliary Tully plant, which is capable of more than doubling the present output of gas. The ceremony was attended by members of the Council and officials and their wives. There were also present Mr. C. B. Tully and Mr. T. Tully, of the firm of Messrs. Tully, Sons, & Co., who installed the plant, and gas managers from neighbouring works. Bailie Hay, Convener of the Gas Committee, presided.

Bailie HAY said that it might not have been known—and in fact they did not wish it to be known—that last year they were several times on the verge of darkness, and it was evident to the Manager and to the Committee that something would have to be done immediately. Their first scheme was very much more ambitious—namely, to bring the plant up to date by installing new retorts—but they discovered it was far too much for them to contemplate at the present time. After making inquiries, they came to the conclusion that the Tully plant was the best for their purpose. He then asked Mrs. Wittet to set the plant in motion.

Mr. C. B. TULLY briefly explained the working of the plant; after which the company adjourned to the Band Hall in Cumming Street, where they were entertained by the Town Council. Bailie HAY then asked Mrs. Wittet to accept a silver bowl from the Committee, as a memento of the occasion.

Lord Provost WITTET, on behalf of the Council and community, expressed indebtedness to those who had contributed to the establishing of the new gas plant. He also expressed appreciation of the way Bailie Hay had given so much personal attention to the scheme.

Mr. TULLY, in reply, thanked the Lord Provost for his remarks.

Councillor S. SOUTER proposed the toast of "Kindred Undertakings and other Gas Managers," and Mr. THOMSON (Inverness) replied.

Ex-Bailie HAMILTON proposed the toast of the "Gas Convener," and referred to the amount of time he had given to the scheme; and Bailie HAY briefly replied.

THE NEW PLANT.

The automatic machine, which entirely operates and controls the working of the new plant, is of particular interest. At the correct moment the machine opens or closes the air valves, gas valves, or steam valves; during the course of five minutes' working this machine makes over twenty separate movements. In addition, it automatically attends to the supply of oil passing to the carburettor. Notwithstanding the multiplicity of functions the machine has to perform, its construction is robust and simple, and the timing of the various operations can be altered, if necessary, while the machine is running. It maintains the operation of the plant at the highest efficiency. The plant is capable of making gas at the rate of over 8000 c.ft. per hour, or nearly 200,000 c.ft. a day.

The comparatively cheap rate charged for gas in Elgin for some years has done much to popularize its use in the town, and the yearly production of the gas-works has steadily increased until it has now reached an output of over 62 million c.ft. per annum.

COLONIAL GAS ASSOCIATION, LTD.

The Fortieth Annual General Meeting of the Association was held in Melbourne on Oct. 3—Mr. P. C. HOLMES HUNT, M.Inst.C.E. (Chairman of Directors), presiding.

The CHAIRMAN said that there had been an increase in the revenue from gas sales of £22,504, and from all sources of £28,930. On the other hand, there had been an increase in expenditure on coal, wages, repairs, &c., of £13,456; a reduction in the bank and loan interest of £1242; while debenture interest had been increased by £6069. The profits available for final dividend amounted to £59,362. The quantity of gas sold was increased by 8·4 p.ct. to a total of 601,240,000 c.ft. The recently installed plant at Footscray had been working most satisfactorily, and over 700 householders in the Sunshine district has been connected, while several industries in this area were also using gas. With regard to the sales organization, an innovation had been adopted in the form of "Gas Weeks," at which special exhibitions of modern gas appliances were held, and cooking demonstrations given daily. These had been arranged in several centres; and they were satisfied that good results were being achieved. Various new showrooms had been established and others remodelled, and had been equipped with the latest and most efficient appliances. The Chairman concluded by thanking his colleagues, and the managers and staffs of the various undertakings, for their co-operation during the year, as a result of which such satisfactory working had been atttained.

Mr. J. S. WEIR seconded the motion for the adoption of the report and balance-sheet, which was carried unanimously.

The CHAIRMAN then moved that a dividend at the rate of 8 p.ct. per annum (*less* interim dividend of 4 p.ct. for the half-year ended Dec. 31, 1927) be paid on the preference shares; that a dividend at the rate of 9 p.ct. per annum (*less* interim dividend of 4½ p.ct. for the half-year ended Dec. 31, 1927) be paid on the ordinary shares; that £4000 be added to the reserve fund; that £10,000 be set aside for Australian income-taxes on profits earned to June 30, 1928; and that the balance (of approximately £14,100) be carried forward to the next account.

Mr. J. S. WEIR seconded this resolution, which was carried unanimously.

CO-PARTNERSHIP ENTERTAINMENT AT RYDE.

In connection with their co-partnership scheme the Directors of the Ryde Gaslight Company entertained their employees and their wives at tea in the Foresters' Hall, Ryde, on Nov. 14. Mr. F. W. RANDALL (Chairman of the Directors) presided, and was supported by Messrs. E. G. Mears (Deputy-Chairman), G. Fardell, C. Langdon, and F. W. Taylor (Engineer and Secretary).

Following the meal the Chairman said the Directors were quite satisfied with the way the co-partnership scheme was working, and it was a success because it proved that everybody connected in any way with the Company had one common idea. The scheme was certainly good for the consumer, because it tended to reduce the price of gas. It was good for the co-partner, because, as the price of gas went down, it tended to increase the amount of bonus to be divided; and it was certainly good for the stockholders, because the interest on their money depended on the reduction in the price of gas, and the way in which the business of the Company was carried on. When the scheme was started the Company put in £500 which, divided among the employees, gave them a non-withdrawable bonus of £7. As a result of the year's working they had received £4 withdrawable bonus, and £4 non-withdrawable bonus, which made their holding £11. On March 1 it would be transferred, so that each co-partner would have £10 worth of stock in the Company, and from that date it would bear interest at 7½ p.ct. in place of 5 p.ct. If a co-partner at the age of 25 remained in the employ of the Company until he was 65, and put the whole of his money into it, at the end of that period he would have standing to his credit nearly £1080. He was able to announce that from Dec. 1 the price of gas would be reduced by one penny per therm, which would add a considerable bonus to be divided in about a year's time. On the motion of Mr. S. H. RICHARDSON (Works Manager) a cordial vote of thanks was passed to the Directors, and in reply Mr. E. G. Mears said he felt that the splendid cordial relationships that had existed between the employees and the Company were so firmly established that it was utterly impossible for a rift in the lute to take place.

TOTTENHAM GAS-WORKS VOLUNTARY BRIGADES.

Annual Dinner.

Never in the history of the Tottenham Gas-Works Voluntary Brigades has the annual dinner and entertainment been attended with such success as on Thursday, Nov. 22, when every seat was occupied in the assembly room of the club in Willoughby Lane.

Mr. H. C. SMITH, Chief Engineer of the Tottenham Gas Company (President of the Brigades), took the chair; and after the Loyal Toast had been duly honoured,

Mr. H. P. MORLEY, Chief Officer of the Brigades, gave the toast of "The Directors of the Company and the Chief Engineer." This was the fifth successive occasion on which he had proposed the leading toast. The Company was managed by as fine a body of men as existed in any large works, he said, and their work was very patent to the employees. The Brigades Chairman, who was Chief Engineer of the Works, had done a great amount of good for the brigades, despite the fact that his time throughout each day was fully occupied. It was never any trouble for their Chairman to be with the brigades, and this was tangible evidence of his personal interest in the welfare of three sections of the brigades—St. John Ambulance, Fire Brigade, and Rescue Crew.

CO-OPERATION AND SUCCESS.

The CHAIRMAN, responding, said that the realization that this was the fifth annual dinner brought home to him the swift flight of time, in so far as it seemed quite recent that the brigades had met under such happy conditions for the first time. Though the workers did not often see the Directors, he could assure them that the management fully appreciated all that had been done by the brigades, not only in their official capacity, but as co-partners and employees of the Company. It was impossible to attain industrial success without the contented co-operation of the workers, and whatever success the Company might enjoy was due, not to one member of the firm, but to everybody whose heart was in the work day in and day out through the year. Many people did not realize that the gas industry had been steadily improving and increasing for well over a hundred years. The Tottenham Gas Company had started from very small beginnings, and he (the Chairman) could well remember the stories of the late Mr. Randell—who had risen from office boy to Director—concerning the progress of the Company. The tremendous increase in the industry could be gathered from the fact that no less than 200,000 tons of coal was being used at the Tottenham Gas-Works each year. The Company served 96,000 consumers with gas for light, as well as for cooking and heating to a population of about half-a-million. It was now common knowledge that the Tottenham Company had taken over the Waltham Cross Company, and that from the first day next year would be supplying that area. The Company would then be distributing gas over sixty square miles, which was no small undertaking. Such fine success had only been brought about by the willingness and loyalty of the workers, without whose assistance the Directors would find it impossible to make such headway.

The next toast, that of "Officers and Brigades," fell to the CHAIRMAN, who briefly enumerated the activities of the different sections. What was most pleasing of all, he said, was that in each case full strength in membership was recorded. The St. John Brigade had done duty at public places on 102 occasions this year, had rendered first-aid to over 2000 cases at the works, while ambulance drivers had taken 145 cases to hospitals. The Fire Brigade had attended seven fires; and the Rescue Crew had done duty 26 times, and showed all-round efficiency.

Response was given by Mr. MORLEY (for the Fire Brigade), Dr. SCOTT (Ambulance), and Mr. J. WHITE (Rescue Section).

CO-PARTNERSHIP AT BROADSTAIRS.

There was an interesting gathering at the Grand Hotel, Broadstairs, on Wednesday, Nov. 21, when the fifth annual dinner of the co-partnership employees of the Broadstairs Gas Company took place. Mr. E. L. Burton presided over an attendance of over 100, including the Directors, employees, and a number of guests.

The CHAIRMAN mentioned the principles of co-partnership, and emphasized the success which had followed its inception at Broadstairs. He traced the method by which the Directors desired to make every employee of the Company, who remained with them a sufficient time, a "capitalist" in the real sense of the word, by setting aside out of the profits distributable year by year to the stockholders a certain proportion (in this case 7 p.ct.) to be invested in the Company's stock held by trustees on behalf of the co-partners. He, with his co-Directors, hoped that they would become capitalists at least to the extent that they would all be able to buy their own houses; for that purpose the building societies were a great help. He touched briefly on the progress of the Company, referring to the dark days of the war when a large part of the population, representing perhaps the bulk of their consumers, left the town. The unenviable financial position of the undertaking was in no small measure attributable to this. Progress was naturally slow, but he was glad to say that conditions had been gradually improving, and he could confidently state that, among other things, relations between the Directors and officers on the one hand and the employees on the other had never been so smooth and settled as they were now.

Returning to the advantages of co-partnership, the Chairman explained that the allotments made to employees were entirely in the nature of a gift, since it was over and above anything they received (or would have received if co-partnership had not been inaugurated) as wages. With his colleagues in other companies with which he was associated, he came to the conclusion that the right scheme to adopt was to allot each man an equal share instead of a percentage based on each employee's annual earnings. In other instances known to him, this had been found to be the best system; and it was therefore adopted at Broadstairs. On the allotments of profits the co-partners were obtaining an eminently satisfactory return. On their part the Company expected and received the goodwill of the co-partners, coupled with their best work. The Chairman also gave brief details of the pensions scheme adopted by the Company for the benefit of employees—the scale being similar to that of the Civil Service.

In conclusion, Mr. W. DALLAS (Secretary) thanked Mr. Burton very warmly for the excellent work he had accomplished for the employees of the Company.

GREENOCK GAS DEPARTMENT.

Annual Report of Mr. G. Keillor.

In his report of the working of the Greenock Corporation Gas Department for the year ended May 15, Mr. G. Keillor, the Engineer and Manager, states that during the year the capital account was increased by £8743, due to expenditure on liquor and sulphate of ammonia plants, vertical retorts, additional main and service pipes, meters, and stoves. The quantity of coal carbonized amounted to 31,354 tons, a decrease of 720 tons on the previous year. The total amount of gas made was 656,057,000 c.ft., as compared with 626,005,000 c.ft. during the previous year. The gas unaccounted for amounted to 3·39 p.ct.; the quality, as certified by the Gas Examiner, was 413·4 B.Th.U., and the maximum daily make was 2,583,000 c.ft. Satisfactory sales of coke, tar, ammonia, &c., were maintained. Gas was distributed throughout the district by a total of over 80 miles of mains, and the over-all average price was 7·53d. per therm. During the period under review, the vertical retort installation has been completely rebuilt and modernized, and about doubled in capacity. In the near future the workshops and stores, it is stated, will have to be enlarged.

The total revenue for the year amounted to £105,796, and in addition there was a balance brought forward from the previous account of £2604; and after the deduction of all expenditure, there remained a balance of £3380 to be carried forward to the next account.

SWANSEA VETERANS HONOURED.

Two veteran members of the staff of the Swansea Gas Light Company, Mr. E. T. Oxenham (Accountant and Assistant Secretary), and Mr. Charles Standish (Rental Superintendent), each of whom has completed fifty years' service with the Company, were honoured at a dinner held at the Osborn Hotel, Langland, on Nov. 27, when they received mementoes of the occasion from the Directors and staff. Mr. E. H. Leeder, Chairman of the Directors, presided, supported by other Directors and various members of the staff.

Mr. W. H. JOHNS, Engineer and Manager, referring to the object of the gathering, remarked that it did not fall to the lot of everybody to continue working for one company for so long a period as Messrs. Oxenham and Standish had done. Though such instances of long service were relatively rare, it was no doubt to the advantage of a company that such continuity of service should be maintained. They were fortunate in having Directors who encouraged that aim. Various schemes had been initiated by the Board for the benefit of their employees, such as co-partnership and superannuation schemes. The growth of the Company during the fifty years Messrs. Oxenham and Standish had served under it had been remarkable. Since 1901 the amount of business had increased no less than 222 p.ct. He hoped the next fifty years would witness a similar increase. Personally he had every confidence in the possibilities of the Company, particularly with regard to the cooking and heating load. In conclusion, Mr. Johns said they felt greatly honoured at the presence of the Directors.

Mr. E. ABLETT, the Secretary and Assistant Engineer of the Company, observed that it was a pleasure to pay tribute to their friends and colleagues, Messrs. Oxenham and Standish. That celebration was one which was unique in the history of the Company, and as far as the two guests were concerned would, he was sure, be a manifestation of the esteem, respect, and affection in which they were held by the Directors, management, and staff alike.

The authorized capital of the Company was nine times as great as when their friends joined, and they had seen the building up of the works at Oystermouth Road, and in more recent years the erection of those at Morriston. Their friends had served under four different managements, and had proved themselves very capable and efficient servants. The employees of the Company had always been favoured with a thoughtful Directorate.

Mr. LEEDER, in an amusing and reminiscent speech, recalled his long association with Messrs. Oxenham and Standish. It was given to very few to go into the service of a public utility undertaking, and remain in it for a lifetime. These two gentlemen owed it entirely to their own energy and ability that they occupied their present position to-day. Mr. Leeder then handed them each an inscribed gold cigarette case as souvenir gifts from the Directors. The toast of the evening was enthusiastically honoured, and the two recipients responded.

The toast of "The Company" was proposed by Mr. W. Crutchley, and responded to by the Chairman, who spoke appreciatively of the staff, and recalled past Directors who had done great work for the Company. On behalf of the staff, Mr. I. Prater and Master C. Harding presented inscribed walking-sticks to Messrs. Oxenham and Standish, while Miss Bullerwell expressed the good wishes of the lady members of the staff.

During the evening a musical programme was contributed.

TAR OIL SPRAYING.

Its Importance in Fruit Growing.

The importance of the spraying of fruit trees with tar oil is becoming more generally recognized; and two hundred fruit growers attended a Town Hall meeting at Evesham on Monday of last week, which was arranged under the auspices of the Evesham and District Market Gardeners' Association, to hear an address on "Tar Oil Spraying" by Mr. Theodore Parker, of the Abol Research Laboratories.

The MAYOR (Alderman Byrd), who presided, pointed out that until a few years ago very little spraying and washing had been done by growers in the Evesham district. Spraying of fruit plantations, properly carried out, greatly increased the cost of running a fruit plantation; but this extra cost would have to be borne by the successful grower of the future.

Mr. THEODORE PARKER observed that tar oil wash was introduced into England about five years ago, and had had considerable and extended use with varying degrees of success. In the early days of its introduction, people seemed to think that tar oil wash was merely ordinary emulsified creosote oil. They quickly found, however, that it was made of specially selected and blended oils, to obtain a high percentage of efficiency in destroying insect eggs. Time of application of the oils was important. Tar oils had to be used when the trees were in an absolutely dormant condition. This meant that plums, and fruit such as cherries and pears, should be sprayed in December, or not later than early January. Time of application had also to be guided largely by weather conditions; and it was advisable to spray after a period of frost, because then the trees had been considerably hardened and were not likely to be damaged. It was fatal to apply tar oil wash during rain. Mr. Parker quoted figures showing that the average weight of apples grown on a tree which had been sprayed with tar oil wash was infinitely greater than that of apples from trees which had been sprayed with other washes, and also that from non-sprayed trees.

THE IMPORTANCE OF GAS IN INDUSTRY.

An Engineering Supplement, recently produced by the "Western Mail," contained several interesting articles with regard to the gas industry and to carbonization generally, contributed by very well-known experts. Among the various subjects dealt with were "Low-Temperature Carbonization," by Mr. S. R. Illingworth; "Coking and Bye-Products;" and "Coal Handling Plant in South Wales." There was also an interesting article entitled "Importance of Gas in Industry."

At the present time, it stated, the question of the use of fuel in industry is very much in the public mind; and that the question is one of considerable importance is brought home by the attention paid to it both by our public men and by the newspapers.

It is interesting to compare the power costs in industry with the total costs of the finished product. Below are some of the power costs in a few important industries.

Shipbuilding and marine engineering (Tyneside), 1¼ p.ct.; large representative engineering firm in Halifax, 0·8 p.ct.; cotton-spinning firm, 0·8 p.ct.; large brewery in the Midlands, 1 p.ct.; engineering firm in Liverpool, 0·8 p.ct.; iron foundry in Northumberland, 0·7 p.ct.; and a large foundry in South Wales, 1 p.ct.

The slogan of "cheap power" as a panacea for industrial depression is a thoroughly misleading one, for heat is by far the more important. In fact, it is true to say that the most essential factor in industrial efficiency is the provision and application of heat. The first question with regard to fuel is obviously, Is it economical? And here we must be careful to distinguish between economy and cheapness; for the economy of a fuel depends on something more than the initial fuel costs. There are important incidental economies in its use which turn the scale, such as the saving of labour and of space, the elimination of disposal of ash and clinkers, and the abolition of smoke and soot.

There are many processes in industry in which gas immediately commends itself as an ideal fuel. In the textile trades, boot-making, and the motor car industry, the cost of fuel is a minor consideration, while convenience, cleanliness, labour-saving, and evenness and exactitude of temperature are the factors that count. In such industries the use of gas is increasing rapidly. Take next those industries in which the cost of fuel is a more important item, but where the exactness of application of the heat is of paramount importance. Progressive managers are finding that the use of clean, regulatable heat not only possesses the general advantages mentioned above, but reduces the amount of waste.

TRADE NOTES.

Celite Products Corporation Purchased.

The Celite Products Corporation, Windsor House, 46, Victoria Street, S.W. 1, advise us that the Johns Manville Corporation have purchased the Celite Company and all their subsidiaries. The entire organization will be taken over as one unit, and business will be carried on as previously.

The Scottish Tube Company, Ltd.

A new catalogue, No. 6, has been published by the Scottish Tube Company, Ltd., which deals with main steam pipes, hydraulic tubes, and tubular coils. Particulars and illustrations are contained of bends, branches, and other classes of tubes and accessories which modern installations necessitate. The catalogue includes British Standard Tables D to K of pipe flanges, and other useful information.

COAL TRADE REPORTS.

From Our Own Correspondents.

NORTH-EAST COAST.

With a return of calmer weather, immediate prospects are much improved. The past week has again proved very difficult, owing to boats being held up on all sides. Many collieries have been standing idle, and the shipping places have been nearly empty.

For the next few weeks shipments are expected to be brisk, as there is generally anxiety to complete business before the holidays and the turn of the year. Prospects ahead are still regarded hopefully. Inquiry for next year continues to give satisfaction, and there are signs here and there of business returning to this market.

Gas coals are reported as a better market, and especially the good qualities are firming up. Wear Specials are quoted at 15s. to 15s. 3d. f.o.b., and best qualities at 14s. 9d. Turns are becoming harder to arrange. Seconds are still plentiful, however, at 13s. to 13s. 6d.

Coking coals are quiet, and demand is disappointing. They are quoted at 13s. to 13s. 6d. according to quality. Bunker trade has been adversely affected by the bad weather; but the forward demand for best qualities remains satisfactory. Best Durham sorts are quoted round 14s.; but others are plentiful at 13s. f.o.b. Northumberland steams are well sold as regards screened sorts, and best qualities ask 14s. to 14s. 3d. Smalls, in some cases, are hard to sell, and stocks are accumulating.

The gas coke trade is slow, and the demand is not up to expectations. The current quotation for shipment is about 19s. 6d. f.o.b.

YORKSHIRE AND LANCASHIRE.

Gas coals in Yorkshire and Lancashire are not expected to maintain prices above those operating last year.

Industrial fuel has been in fair request for forward delivery, the indications being that last year's prices will operate in renewals of contracts for washed nuts.

The shipping outlook is unchanged.

Domestic orders during the past week have not reached anticipated figures. Prices generally have been maintained, with better grades not so predominant as formerly.

The following are the Humber bunker and export prices (f.o.b. usual shipping ports):

South Yorkshire—Hards, Association, 19s. 3d. to 19s. 6d., export 16s. to 16s. 6d.; washed trebles, 15s. 6d., export 16s.; washed doubles, bunkers 17s. to 17s. 3d., export 15s. to 15s. 3d.; washed singles, export 14s. to 14s. 3d.; washed smalls, bunkers 13s. 9d., export 10s. 9d. to 11s.; rough slack, bunkers 12s. 6d. to 13s., export 8s. 6d. to 9s.; and smithy peas, export 16s. 6d. to 17s. 6d.

West Yorkshire—Hartley's (f.o.b. Goole), bunkers 16s. 3d. to 17s. 3d., export 14s. to 15s.; screened gas coal, export 14s. to 15s.; washed trebles, export 15s. to 15s. 6d.; washed doubles, export 14s. to 14s. 6d.; washed singles, export 13s. to 13s. 3d.; washed smalls, bunkers 13s. 3d., export 10s. to 10s. 6d.; unwashed trebles, export 14s. 6d. to 15s.; unwashed doubles, export 11s. 6d. to 12s.; rough slack, export 8s. 9d. to 9s. 3d.; and coking smalls, export 8s. 6d. to 9s. 3d.

Derbyshire and Nottinghamshire—Top hards, bunkers 19s. 3d. to 19s. 6d., export 15s. 6d. to 16s. 6d.; cobbles, export 15s. 6d. to 16s.; washed trebles, export 15s. 6d. to 16s.; washed doubles, export 13s. 6d. to 14s. 3d.; washed singles, export 13s. to 13s. 6d.; washed smalls, bunkers 13s. 6d. to 13s. 9d., export 10s. 6d.; unwashed doubles, export 12s. to 13s.; and rough slack, bunkers 12s. 6d. to 13s., export 8s. 6d. to 9s.

Yorkshire, Derbyshire, and Nottinghamshire—Screened steam coal, bunkers 17s. to 18s., export 13s.; gas coke, export 21s. to 22s. 6d.; furnace coke, export 19s. to 19s. 6d.; washed steams—Goole, West Yorks. bunkers 16s. to 16s. 6d., Hull, West Yorks. bunkers 17s. to 17s. 3d., Hull, South Yorks. bunkers 17s. 3d., export 14s. 6d. to 15s., all per ton.

MIDLANDS.

There have been only minor fluctuations on demand. Rather more activity with regard to slacks has put no noticeable strain upon supplies, and values remain very easy. "D.S." nuts and beans are maintaining a somewhat better equilibrium in certain districts; but it is a buyers' market.

With the nearer approach of Christmas householders are paying increased attention to re-fuelling. Merchants are well ahead of the requirements, however, except in the case of those high-grade qualities whose reputation is enhanced by the fact that the output is limited. The industrial demand as a whole shows no real improvement. Few pits are making more than three to four days' work a week.

Land sale fuel for the iron and steel industries is being dealt in under great difficulties owing to the indefinite conditions under which the rebate on railway rates was given. Collieries contend, quite reasonably, that the relief was intended for them as well as for the iron and steel masters; but consignees stand upon the right which payment of the carriage gives them to the reduced charge. The Railway Clearing House in administering the fund can only recognize, it would seem, the particular trader who is accountable to them for the freight.

Merchants who have received from collieries warning notices that they will be held responsible for collecting the rebate on behalf of the coalowner are in a quandary, particularly with regard to running contracts. They make no claim themselves to the State money; but they think it is hard they should be held to judgment both by their suppliers and their customers, and obviously there are other complications.

CONTRACTS OPEN.

Coal.

The Gas Department of the Silsden Urban District Council invite tenders for the supply of gas coal. [See advert. on p. 690.]

Pipes.

The Plymouth Corporation Gas Department invite tenders for the supply of cast-iron gas main pipes, valves, syphons, and specials. [See advert. on p. 690.]

Purifiers.

The Chelmsford Corporation invite tenders for the supply, delivery, and erection of four purifiers. [See advert. on p. 690.]

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Dec.* 3.

There is little change to report in the tar products market, and values are steady as follows:

Pitch, 40s. to 42s. 6d. per ton.
Creosote, about 7d. per gallon.
Pure benzole, about 1s. 8d. per gallon.
Pure toluole, 1s. 11d. to 2s. per gallon.
Solvent naphtha, 95/160, about 1s. 6d. per gallon.
Pyridine, about 5s. per gallon.

Tar Products in the Provinces.

Dec. 4.

Markets for tar products remain dull.

In pitch, there is little or no business doing; but Continental quotations appear to be on the basis of 37s. 6d. to 38s. 6d. f.o.b.

The market for creosote is also very quiet, and little or no business is passing.

Water-white products are still very firm, particularly benzole, which is reported to have been sold at a very good figure for all over next year.

Crude carbolic acid is without alteration. The market for crystals is steady, although the orders are small.

There is no change to report in cresylic acid.

The average prices of gas-works products during the week were: Gas-works tar, 28s. 6d. to 33s. 6d. Pitch—East Coast, 37s. 6d. to 38s. 6d. f.o.b. West Coast—Manchester, 32s. 6d. to 33s. 6d.; Liverpool, 34s. 6d. to 35s. 6d.; Clyde, 34s. 6d. to 35s. 6d. Toluole, naked, North, 1s. 5d. to 1s. 6d. nominal. Coal-tar crude naphtha, in bulk, North, 9d. to 10d. Solvent naphtha, naked, North, 1s. 1½d. to 1s. 2d. Heavy naphtha, North, 1s. to 1s. 0½d. Creosote, in bulk, North, liquid, 5⅝d. to 5⅞d.; salty, 5½d. to 5⅝d.; Scotland, 5½d. to 5⅝d. Heavy oils, in bulk, North, 8¼d. to 8½d. Carbolic acid, 60 p.ct., 1s. 11d. to 2s. prompt. Naphthalene, £13 to £15; salts, £5 to £5 10s., bags included. Anthracene, "A" quality, 2½d. per minimum 40 p.ct., purely nominal; "B" quality, unsaleable.

Benzole Prices.

The following are considered to be the market prices to-day:

	s. d.	s. d.	
Crude benzole	0 10	to 0 10½	per gallon at works
Motor ,,	1 4	,, 1 4½	,, ,, ,,
90 p.ct. ,,	1 7	,, 1 8	,, ,, ,,
Pure ,,	1 10	,, 1 11	,, ,, ,,

Cheaper Gas for Scarborough.—The Scarborough Gas Department have reduced the price of gas from 9½d. to 9d. per therm; or a 7½ p.ct. discount from 3s. 3d. to 3s. 1½d. per 1000 c.ft.

Gas Explosion at Benwell.—The explosion of a gas stove in the Benwell branch of the Newcastle Co-Operative Society was the cause of a serious fire on Nov. 28. At the time of the explosion, the shop was crowded with customers, and the flames spread with great rapidity, completely gutting the premises. A considerable number of treasury notes were destroyed, but fortunately there was no personal injury.

New Aberdeen Gas Charges.—Following the resolution of the Aberdeen Town Council in July last to issue bills to gas consumers quarterly instead of twice yearly, the Gas Committee, at a meeting on Nov. 28, considered the question of rebates and discounts to be allowed, and adopted a block scale of charges applicable to gas used for all purposes. These rates vary from 2s. 3d. to 1s. 8d. per 1000 c.ft., and are to take effect from the December meter readings. Under this scheme discounts will be abolished. Intimation was received from the Secretary of the Scottish Regional Gas Council that, after prolonged negotiations, an agreement was reached whereby the wages of gasfitters are to be advanced to 1s. 4d. per hour. The present rate varies from 1s. 2½d. to 1s. 3d. per hour.

Reduction in Railway Carriage.—Nitram, Ltd., of Victoria Station House, S.W.1 (associated with Imperial Chemical Industries, Ltd.), make the following announcement with regard to railway charges: With reference to the rebates in railway carriage on fertilizers, which have been announced, we understand that these will apply to all consignments forwarded by rail on and after Dec. 1 next. We estimate that the saving to us will amount, on the average, to 1s. per ton on those fertilizers which we sell on carriage paid terms—viz., sulphate of ammonia and nitro-chalk—and it is our intention to credit this to our customers. A reduction for saving in carriage will accordingly be made on invoices for all parcels forwarded by rail on or after Dec. 1, which reduction should be passed on to the ultimate buyers.

Students at a Meter Works.

A visit was paid to the works of Perfecta Meters, Ltd., at Hither Green, on Nov. 24, by the evening-class students in Gas Supply from the East Ham Technical College, where special classes are held for the training of students in gas supply and gas fitting, under the Institution of Gas Engineers Education Scheme. Mr. S. T. Phillips, Senior Lecturer in Gas Supply at the College, was in charge of the party, and was accompanied by Mr. T. V. Garrud, Senior Lecturer in Gas Supply at the Hackney Polytechnic. The party numbered 46, and consisted of students from various London and surrounding gas companies. A demonstration was given of a "Perfecta" meter in the course of construction and under test, and in addition the various types of "Perfecta" meters, with capacities ranging from 40 c.ft. to 3000 c.ft. per hour, were exhibited. Before leaving Mr. Phillips expressed his thanks on behalf of the party for the interesting time spent.

Cheaper Gas at Llandudno.—The Llandudno Gas Committee are recommending to the Council that the price of gas should be reduced by 3d. per 1000 c.ft.

Re-Assessment of the Congleton Gas Department.—The re-assessment of the Congleton Gas Department under the new Rating and Valuation Bill has increased the value from £1000 to £2000, which is 30 p.ct. higher per million c.ft. of gas sold than the average of 73 gas undertakings in the Midlands. Some concern is being felt by the consumers on this account, for the new assessment represents an approximate increase in the price of gas of 1½d. per 1000 c.ft. in Congleton.

Gas Exhibition at Rhyl.—On Nov. 26, Councillor T. J. Edwards opened the first municipal Gas Exhibition that has ever been held at Rhyl. New premises were opened where, all the year round, there will be exhibited the latest gas appliances. Referring to the recent development of the gas undertaking, Mr. T. Amos, Clerk to the Council, stated that upwards of 300 houses in the newly-added urban district had been supplied with gas in the course of the last twelve months. Since the Council took over the concern, £30,000 had been allocated out of the gas profits to the relief of the rates.

Fatal Accident at York Gas-Works.—At the recent inquest on Mr. A. J. Daish, an analytical chemist engaged in the technical department of the York Gas-Works, who had fallen into a tank of liquid lime heated to a temperature of 212° Fahr., Mr. G. Le Boutiller Diamond, the Works Manager, stated that deceased was taking a sample of effluent matter for research purposes, and stepped on to a plank which was across the tank, instead of taking the sample from the side, evidently thinking a better sample, from a chemical point of view, could be obtained from the centre of the tank. A verdict of "Accidental death" was returned, and a rider was added that there should be a proper scoop for the taking of samples.

Travelling Showroom for Bradford.—The Bradford Corporation Gas Committee have recommended the City Council to approve the purchase of a travelling gas showroom, at a cost of £500, to provide displays of domestic gas appliances. The Estimates Sub-Committee have endorsed the scheme, so that, in all probability, it will receive the Council's sanction shortly. The Chairman of the Gas Committee (Alderman G. Wilkinson) and the Engineer and General Manager (Mr. E. J. Sutcliffe) were much impressed by their visit to the York Gas Company's travelling showroom during the recent "B.C.G.A." conference. Since then the Bradford Gas Committee as a whole have inspected the vehicle, and were so convinced of its utility that they decided to seek powers to build one on similar lines for Bradford.

During the recent storm, 3800 gas mantles were broken in the Bradford street lamps. Last year, during the bad gale, 8000 were broken; and as a result, a new system of fixing was adopted, which probably accounts for the reduced number of breakages.

A gas explosion occurred in a house at Bolton-on-Humber while workmen from the Gas Company were carrying out some repairs. The tenant sustained a fractured leg, and the workmen were severely shaken, but escaped injury. The front of the house was completely wrecked.

Pontefract Gas Department employees, summoned to an escape of gas which had caused an explosion in a house in Gillygate, on Nov. 27, traced it to a neighbouring house and shop, in the cellar of which was found the dead body of a man, who was lying with his head over a gas ring under a pile of cushions, the gas being turned full on.

Three employees of the Blackpool Gas Department received presents, on Nov. 30, from their fellow-workers on the occasion of their retirement at the age of 70 years. The recipients were Messrs. W. C. Ormond, pipe fitter (50 years' service); J. Jagger, lamp lighter (30 years' service); and W. Hall, works lighting department (14½ years' service).

At the recently completed enginemen's hostel at Chalk Farm, where the drivers and firemen of the L.M.S. Railway can lodge when their duties necessitate their taking a rest away from home, there is provided in the mess room a large gas stove with oven of sufficient size to allow of several men cooking simultaneously whatever food they may have brought with them.

The Leeds Gas Department have installed an extensive gas cooking, water-heating, and central heating equipment at the new store of Messrs. F. W. Woolworth & Co., Ltd., in Briggate, Leeds, which was opened on Dec. 1. The new store is on a much larger scale than the previous one, and includes a restaurant, on the cafeteria self-help principle, capable of accommodating 500 persons. The whole of the cooking is done by gas.

STOCK MARKET REPORT.

WHEN the terms of the Government conversion scheme were announced, the market for British Funds became more normal; but in the other markets conditions were extremely unsettled owing to persistent realizations

In the Gas Market, notwithstanding rumours of a general decrease in the sale of the commodity during the past month, due to the abnormally mild weather, the interest was still maintained. The feature of the week was the sensational rise of 13 points in the Lea Bridge 5 p.c. ordinary; and, having regard to the strength of the Company's financial position, the improvement in the quotation is fully justified. The steady increase in the sales of gas for many years, and the low amount of capital employed, to which attention was drawn in the "Potential Investment" article in the issue of Nov. 7 (p. 388), makes this stock particularly attractive. The yield at the present average quotation of 112½, calculated on the dividend paid for the first half of the year (7½ p.c. per annum), is £6 13s. 4d. p.c. A curious feature of the rise is that no transactions were recorded during the week. Some activity took place in the Colombo £1 shares (dividend 5 p.c. f.o.t.), and the quotation was marked up 2s. to 41s.-43s.; but otherwise there were no important variations.

The following transactions were recorded during the week:

On Monday, Alliance and Dublin 97½, 4 p.c. deb. 65, 65½, Bournemouth "B" 12⅞, 12⅝, 12⅝, Cardiff 97¼, European 8, 8⅛, Gas Light and Coke 18s. 8¼d., 18s. 9d., 18s. 10½d., 19s., 3½ p.c. 63¾, 4 p.c. pref. 78⅛, 78¼, 78⅜, 3 p.c. deb. 60⅜, Imperial Continental 167, 168½, Montevideo 96, 96½, Primitiva 23s. 4½d., 23s. 6d., 23s. 9d., 23s. 10½d., 24s., South Metropolitan 107, 107½, 107¾, South Suburban 5 p.c. deb. 101, Tottenham "B" 103, Wandsworth "C" 102½, Wimbledon stock 109½, new ordinary 102½. Supplementary prices, Bath 4 p.c. deb. 74, Brighton and Hove 4 p.c. deb. 77, Liverpool 5 p.c. 90½, Metropolitan (Melbourne) 5¼ p.c. deb. 100½, Montevideo 5 p.c. deb. 88, South Suburban new 5 p.c. deb. 100, Swansea 5 p.c. max. 78½, 79½.

On Tuesday, Aldershot 4 p.c. pref. 71½, Alliance and Dublin 98, Brighton and Hove 6 p.c. 117, 117¼, 118, British 116, 117, Cardiff 7½ p.c., deb. 102½, Continental Union 7 p.c. pref. 94½, Croydon sliding-scale 111½, 112½, maximum dividend 85, European 8¼, Gas Light and Coke 18s. 9d., 18s. 9⅜d., 19s., 4 p.c. pref. 79, 3 p.c. deb. 61½, Imperial Continental 167, 168, 168½, Primitiva 23s. 6d., 23s. 9d., South Metropolitan 107, 108, Tottenham "B" 102½. Supplementary prices, Gas Light and Coke 5 p.c. deb. 102½, Liverpool 5 p.c. 90½.

On Wednesday, Bournemouth "B" £12 11s. 9d., Brighton and Hove 5 p.c. 103½, 104, Bristol 5 p.c. 91½, Colombo 42s., 43s., Continental Union 38½, 7 p.c. pref. 94½, Croydon sliding-scale 112½, European 8 3/16, 8⅛, 8¼, Gas Light and Coke 18s. 9d., 18s. 10¼d., 4 p.c. pref. 78, 78⅜, 79¼, 3 p.c. deb. 60¼, Imperial Continental 167, 167½, 168, 168½, Primitiva 23s. 3d., 23s. 6d., 23s. 9d., South Metropolitan 107, 107⅝, 107½, 108, South Suburban 5 p.c. 99. Supplementary prices, Bournemouth new 6 p.c. pref. £11 7s. 9d., Gas Light and Coke 5 p.c. deb. 1952-57 100⅛, 101, 102¼, Lewes additional 7 p.c. max. 102, Pinner 5¼ p.c. deb. 100½, 101, Southend-on-Sea 5 p.c. deb. 96½.

On Thursday, Bouprnemouth "B" 12 11/16, Continental Union 7 p.c. pref. 94, European 8, 8⅛, 8 3/16, Gas Light and Coke 18s. 7½d., 18s. 9d., 18s. 9⅜d., 18s. 10½d., 4 p.c. pref. 78, 3 p.c. deb. 61, Imperial Continental 167, 168½, Newcastle 16s. 6d., 3½ p.c. deb. 69, Portsmouth 4 p.c. 102. Supplementary prices, Liverpool 5 p.c. 90, 91, Northampton 83, South Shields new 109.

On Friday, Commercial 3 p.c. deb. 59, Continental Union 38, 38½, 7 p.c. pref. 94½, Gas Light and Coke 18s. 7½d., 18s. 9d., 18s. 9⅜d., 18s. 10½d., 3½ p.c. max. 63½, 4 p.c. pref. 78¼, 79⅜, 3 p.c. deb. 60¼, 60½, 60¾, 61¼, Imperial Continental 167½, Primitiva 23s. 1½d., 23s. 4½d., 23s. 6d., 23s. 9d., South Metropolitan 107, 107½, 107⅞, South Suburban 109¼. Supplementary prices, Aldershot 4 p.c. deb. 77, Folkestone 7 p.c. deb. 102, Gas Light and Coke 5 p.c. deb. 102½, Herne Bay original (10 p.c.) 6, additional (7 p.c.) 4½, Liverpool 5 p.c. 91½.

There was exceptional ease in the Money Market at the close of the week despite end of month demands. Fresh accommodation and old loans were generally renewed at 3 p.c., and week-end advances were freely offered at 2¾ p.c. Assisted by the lower Treasury Bill allotments, the average rate of which was £4 5s. 5·23d. p.c., or nearly 2s. 4d. p.c. below the previous week's rate, discount rates were also lower.

On the Foreign Exchange Market, sterling on New York was maintained at 4.85⅛. German marks appreciated to 20.35; Dutch florins 12.07⅜; and pesetas to 30.05. French francs, however, weakened to 124.10½; while Belgas and Italian lire were unchanged at 34.89 and 92.58½ respectively.

Silver on Continental selling was slightly cheaper at 26 5/16d. per oz.; while Gold was unchanged at 84s 11½d. per oz.

The Bank Rate is 4½ p.c., to which it was reduced from 5 p.c. on April 21, 1927. The Banks' deposit rate is 2½ p.c., and the deposit rates of the discount houses are 2½ p.c. at call and 2¾ p.c. at notice.

Issue.	Share.	When ex-Dividend.	Dividends. Prev. Hf.Yr	Dividends. Last Hf. Yr.	NAME.	Quotations. Nov. 30.	Rise or Fall on Week.	Transactions Lowest and Highest Prices.
£			% p.a.	% p.a.				
171,978	Stk.	Aug 30	5	5	Aldershot 5 p.c. max. C.	72—77	..	..
412,992	"	"	4	4	Do. 4 p.c. Pref.	69—72	+1	..
1,551,868	"	Sept. 27	7	7½	Alliance & Dublin Ord.	96—99	..	71¼
574,000	"	July 12	4	4	Do. 4 p.c. Deb.	68—66	..	97¼—98
532,654	"	Aug. 30	7	7	Barnet Ord. 7 p.c.	114—117	..	65—65¼
300,000	1	Oct 11	1/12	1/12	Bombay, Ltd.	20/—22/-	..	..
170,000	10	Aug 30	8½	8½	Bournemouth 5 p.c.	12¼—13½	..	..
1,600,050	10	"	7	7	Do. B 7 p.c.	12¼—12⅝	..	..
375,000	10	"	6	6	Do. Pref. 6 p.c.	11—11⅛	..	12⅜—12 11/16
50,000	Stk.	July 12	3	3	Do. 3 p.c. Deb.	56—59	..	..
162,025	"	"	4	4	Do. 4 p.c. Deb.	75—78	..	..
857,900	"	Aug. 30	7½	7½	Brighton & Hove 6 p.c. Con.	115—118	..	117—118
341,880	"	"	6½	6½	Do. 5 p.c. Con.	101—104	..	103½—104
1,287,500	"	July 26	5	5	Bristol 5 p.c. max.	91½—92¼a	..	..
885,000	"	Sept. 27	7	8	British Ord.	114—117	..	116—117
100,000	"	June 28	7	7	Do. 7 p.c. Pref.	114—117	..	..
120,000	"	"	4	4	Do. 4 p.c. Red. Deb.	74—77	..	..
200,000	"	"	5	5	Do. 5 p.c. Red. Deb.	95—98	..	..
100,000	10	May 24	6	8	Cape Town, Ltd.	8—9	..	..
100,000	10	Oct 25	4½	4½	Do. 4½ p.c. Pref.	6¾—7½	..	..
150,000	Stk.	June 28	4½	4½	Do. 4½ p.c. Deb.	78—78	..	..
626,860	"	July 26	6	6	Cardiff Con. Ord.	97—100	..	97½
337,860	"	June 28	7½	7½	Do. 7½ p.c. Red. Deb.	100—103	..	102½
167,150	"	Aug. 16	6½	5	Chester 5 p.c. Ord.	88—93b	..	..
79,185	1	Oct. 11	12/-	12/-	Colombo Ltd. Ord.	41/—43/-	+ 2/-	42/—43/-
24,495	1	"	1/4⅜	1/4⅜	Do. 7 p.c. Pref.	20/6—22/6	..	..
375,402	1	Oct. 11	1/92	1/9⅜	Colonial Gas Assn. Ld. Ord.	23/6—25/6	..	..
187,848	1	"	1/7½	1/7½	Do. 8 p.c. Pref.	21/—23/-	..	..
2,073,280	Stk.	July 26	7	5	Commercial Ord.	98—101	..	..
475,000	"	June 14	3	3	Do 3 p.c. Deb.	57—60	..	59
800,000	"	Sept. 27	11	11	Continental Union, Ltd.	37—40	..	38—38¼
200,000	"	"	7	7	Do. 7 p.c. Pref.	90—95	..	94—94½
787,560	"	Aug. 16	7	7	Croydon sliding scale	110—113	..	111½—112½
408,100	"	"	5	5	Do. max. div.	84—87	..	85
493,270	"	Aug. 16	10	7	Derby Con.	115—120c	..	..
55,000	"	June 28	4	4	Do. Deb.	..	..	..
309,000	"	Aug. 30	5	5	East Hull Ord. 5 p.c.	71—78c	..	..
1,003,180	10	Sept. 13	16	14	European, Ltd.	75—78	..	..
12,708,480	Stk.	July 26	5/1¼	5½	Gas Light & Coke 4 p.c. Ord.	8—9	..	8—8 7/16
1,600,000	"	"	8½	8½	Do. 8½ p.c. max.	18/9—19/3f	..	18/7½—19/-
4,187,020	"	"	4	4	Do. 4 p.c. Con. Pref.	62½—64½	..	63½—63⅝
5,803,690	"	June 14	3	3	Do. 3 p.c. Con. Deb.	77—80	+1	78—79⅜
181,315	"	"	6	6	Do. 6 p.c. Br'd'd Rd. Db.	60—62	−½	60½—61½
1,642,770	"	"	5	5	Do. 5 p.c. Red. Deb.	104—107	..	..
42,000	"	—	7½	7½	Do. 7½ p.c. Ilford Deb.	100—102	+1	..
89,600	"	Aug. 30	6½	7	Hastings & St L. 5 p.c. Conv	..	..	..
258,740	"	"	5½	5½	Do. 8½ p.c. Conv.	95—100	..	..
70,000	10	Oct. 11	10	10	Hongkong & China, Ltd.	75—80	..	..
173,300	Stk.	Aug. 30	5	5½	Hornsey Con. 8½ p.c.	18—14	..	..
1,976,000	"	Nov. 8	10	10	Imperial Continental Cap.	88—91	..	..
223,130	"	Aug. 16	8½	8½	Do. 8½ p.c. Red. Deb.	167—170	..	167—168½
285,249	"	Aug. 16	7	7½	Lea Bridge 5 p.c. Ord.	67—69	..	..
2,145,907	"	Aug. 16	5½	5½	Liverpool 5 p.c. Ord.	111—114	+13	..
600,000	"	Sept 27	7	7	Do. 7 p.c. Red. Pref.	90—91b	..	..
165,786	"	Aug. 16	8	9	Maidstone 5 p.c. Cap.	101—102b	..	..
63,480	"	June 14	3	3	Do. 3 p.c. Deb.	120—125	..	..
75,000	5	June 14	18	18	Malta & Mediterranean	55—58	..	..
541,930	Stk.	Nov. 22	17	15	Montevideo, Ltd.	5½—6	..	..
2,061,315	"	Aug. 16	5	5	Newcastle & Gateshead Con.	95—97*	..	..
360,929	"	"	4	4	Do. 4 p.c. Pref.	16/—16/9df	+/-/1½	96—96½
891,705	"	June 28	8½	8½	Do. 8½ p.c. Deb.	70—71d	..	..
181,780	"	Aug. 30	6/18/0	7/1/0	North Middlesex 6 p.c. Con.	69½—70½d	..	..
300,000	"	Nov. 22	7	9	Oriental, Ltd.	102—107	..	..
188,190	"	June 28	7½	7½	Plym'th & Ston'house 5 p.c.	112—115*	..	..
414,500	"	Aug. 30	7½	7½	Portsm'th Con. Stk. 4 p.c. Std.	110—113	..	..
236,782	"	"	5	5	Do. 5 p.c. max.	101—104	..	102
2,334,464	1	—	—	—	Primitiva Ord.	79—82	..	..
244,500	100	June 1	4	4	Do. 4 p.c. Red. Deb.	23/—25/-	..	23/1½—24/-
695,000	Stk.	July 26	4	4	Do. 4 p.c. Red. Deb. 1911	91—94	..	..
416,345	"	June 28	4	4	Do. 4 p.c. Cons. Deb.	78—80	..	..
150,000	10	Sept. 27	6	6	San Paulo 6 p.c. Pref.	78—80	..	..
270,000	Stk.	Aug. 30	6	6½	Sheffield A	8½—8⅝	..	..
419,968	"	"	6	6½	Do. B	104—105d	..	..
1,047,000	"	"	6	6½	Do. C	104—105d	..	..
80,000	10	June 14	3	4	South African	104—105d	..	..
6,689,895	Stk.	July 26	7½	5	South Met. Ord.	4—6	..	..
500,000	"	"	6	6	Do. 6 p.c. Irred. Pf.	106½—108½	..	107—108
1,895,445	"	July 12	8	8	Do. 8 p.c. Deb.	110—113	..	..
734,000	"	Sept. 13	6½	6½	Do. 6½ p.c. Red. Db.	59—61	..	..
91,500	"	Aug. 16	8½	8½	South Shields Con.	100—102	..	..
1,243,795	"	July 26	6½	6½	South Suburban Ord. 6 p.c.	109—110d	..	..
368,827	"	June 28	5	5	Do. 5 p.c. Deb.	108—111	..	..
647,740	"	Aug. 30	5	5	South'mpton Ord. 5 p.c. max.	98—101	..	102½
121,275	"	June 28	4	4	Do. 4 p.c. Deb.	77—79	..	99—101
350,000	"	Aug. 30	7	7	Swansea 7 p.c. Red. Pref.	72—75	..	..
200,000	"	June 28	6½	6½	Do. 6½ p.c. Red. Deb.	101—103	..	..
120,000	"	July 26	7½	8	Tottenham District A 5 p.c.	101—103	..	..
682,275	"	"	6½	6½	Do. B 5½ p.c.	117—122	..	..
150,000	"	"	5½	5½	Do. C 5½ p.c. Pref.	100—103	..	102½—103
121,255	"	June 14	4	4	Do. 4 p.c. Deb.	96—99	..	..
239,694	"	Aug. 30	6 5/8	6⅝	Uxbridge, Maidenhead, & Wycombe 5 p.c.	76—79	..	..
28,830	"	"	5	5	Do. 5 p.c. pref.	93—98	..	..
30,000	"	July 12	8½	8½	Wandsworth, Wimbledon, and Epsom— Wandsworth A 5 p.c.	87—92	..	..
255,636	"	"	7	7½	Do. B 5½ p.c.	130—135	..	..
432,535	"	"	5/19/0	6½	Do. C and New	113—118	..	..
852,000	"	"	6⅝	6⅝	Do. Wimbledon 5 p.c.	99—104	+1	102½
98,000	"	"	7½	7½	Do. Epsom 5 p.c.	107—112	..	109½
210,000	"	"	5	5	Do. 5 p.c. Pref	115—120	..	109½
54,416	"	June 28	8	8	Do. 3 p.c. Deb.	88—91	..	..
254,743	"	"	4	4	Do. 4 p.c. Deb.	57—60	..	..
207,500	"	"	..	5	Do. 5 p.c. Deb.	76—79	..	..
						98—100	..	..

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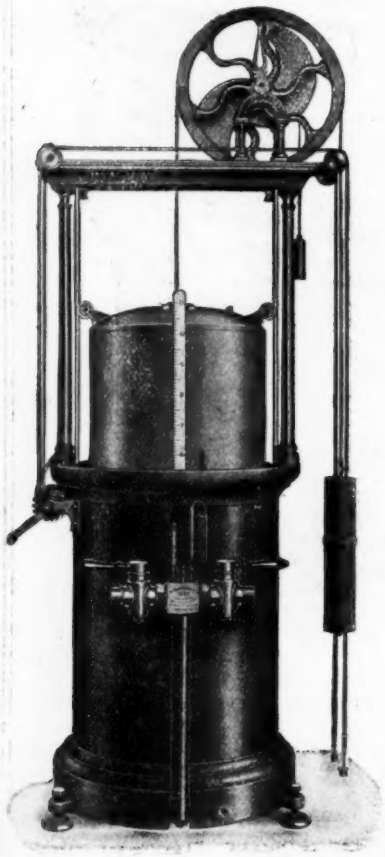

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